

# PATENT ABSTRACTS OF JAPAN

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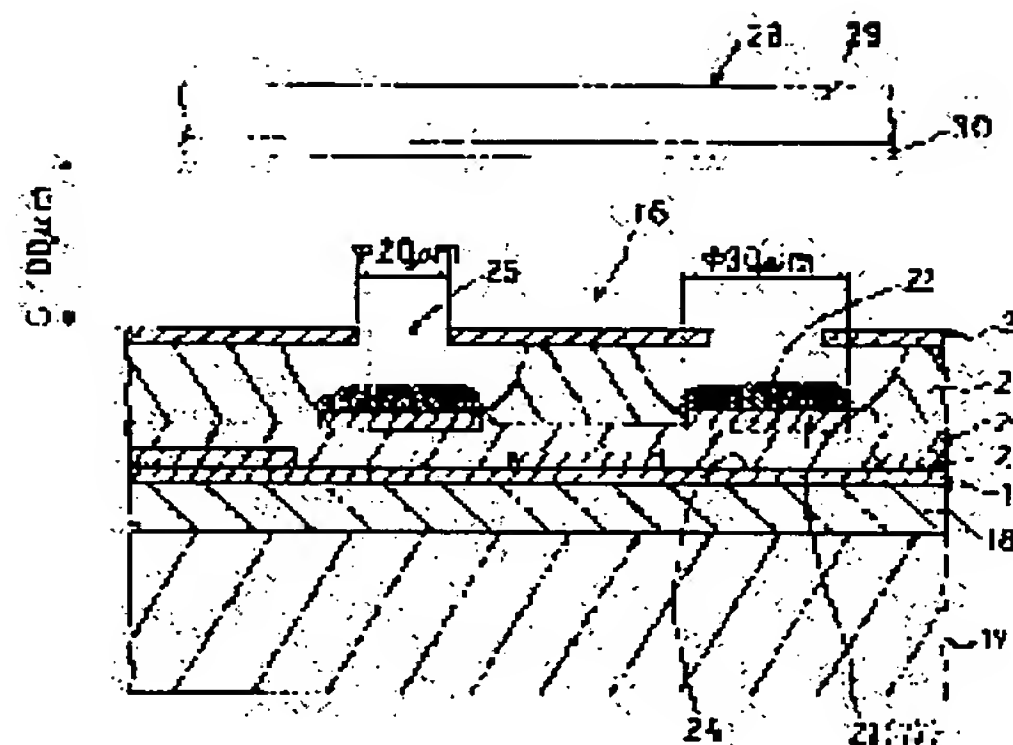
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## (54) ION WRITE HEAD

### (57)Abstract:

**PURPOSE:** To provide an ion write head which has high ion utility efficiency in a small size.

**CONSTITUTION:** An ion write head 16 forms an electrostatic image by selectively adhering charged particles on a latent image carrier 28 formed of dielectric unit, and comprises a plurality of individual electrodes 21 formed on a board 17, an electron emitting unit 22 which is formed on the electrodes 21 and can emit electrons to form the particles by heating, a heater 24 for heating the unit 22, and a gate electrode 26 for accelerating the electrons emitted from the unit 22.



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CLAIMS

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[Claim(s)]

[Claim 1] Two or more individual electrodes which are the ion write head which a charged particle is made to adhere selectively and forms an electrostatic latent image on the latent-image support constituted with a dielectric, and were formed on the substrate, The electron emission section which may emit the electron for generating a charged particle by being formed on said individual electrode and heated, The ion write head characterized by having a heating unit for heating said electron emission section, and a gate electrode for accelerating the electron which collaborated with said individual electrode and was emitted from said electron emission section.

[Claim 2] The ion write head according to claim 1 characterized by said individual electrode making said heating unit serve a double purpose.

[Claim 3] The ion write head according to claim 1 or 2 characterized by forming said electron emission section considering a ferroelectric as a subject.

[Claim 4] The ion write head given in any 1 term of claim 1 characterized by having the actuation circuit which makes said heating unit generate heat to predetermined timing thru/or claim 3.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the suitable ion write head for the electrostatic recording equipment which the charged particle corresponding to an image is made to adhere selectively from the exterior, and forms an electrostatic latent image on the latent-image support constituted with a dielectric.

[0002]

[Description of the Prior Art] While the mechanical reinforcement of latent-image support is high in recent years as compared with the photo conductor used as latent-image support in the conventional electrophotography method and using the latent-image support formed with the dielectric which is excellent also in the stability over temperature or a repeat. At high speed, the printer of the ion write-in formula which forms an electrostatic latent image using a charged particle (ion) instead of the conventional light has dramatically much printing number of sheets, and is used abundantly at few [ the frequency of a maintenance ] business-use high-speed printers etc. And since control of latent-image potential is easy as compared with the printer of the electrophotography method which used the photo conductor, by controlling the coating weight of developers, such as a toner, the printer of an ion write-in formula is suitable for printing which has concentration gradation, and suitable for the full color printer than to which greater importance is attached to the repeatability of concentration gradation.

[0003] Hereafter, such the conventional ion write head is explained.

[0004] Drawing 22 shows an example of the conventional ion write head, (a) is the perspective view showing the whole configuration, and (c) is [ (b) is drawing of longitudinal section showing the configuration of an important section, and ] the explanatory view showing the arrangement condition of a line electrode and a finger electrode.

[0005] As shown in (a) of drawing 22, the screen electrode 2 is formed on the surface of one side, two or more openings 3 are arranged and formed in the front face serrate, and the conventional ion write head 1a is made abbreviation plate-like as a whole. And as shown in (b) of drawing 22, the screen electrode 2, the finger electrode 4 with opening 3, and the line electrode 5 are arranged through the insulating layer 6 which consists of a desired dielectric, respectively. Moreover, as shown in (c) of drawing 22, the opening 3 of the finger electrode 4 and the line electrode 5 are arranged in the shape of a matrix. And as shown in (b) of drawing 22, each opening 3 is arranged in it as ion write head 1a counters the latent-image support 7.

[0006] In such conventional ion write head 1a, by the actuation circuit of the request which is not illustrated between the finger electrode 4 and the line electrode 5, the frequency of 1MHz and about [ electrical-potential-difference 1kV ] high-frequency voltage are impressed, and the ion 8 ((b) of drawing 22) as a charged particle by discharge is generated in the atmospheric air of the circumference of the finger electrode 4. Moreover, as shown in (c) of drawing 22, two or more line electrodes 5 are formed, and high-frequency voltage is impressed to one of them one by one. And the direct current voltage of -600V is impressed to the screen electrode 2, and the electrical potential difference of -400V



is impressed to the finger electrode 4 at the time of -700V and printing at the time of standby.

Furthermore, pulse width at the time of printing is made about [ 20micro ] into S, and for example, it generated in the atmospheric air of the circumference of the finger electrode 4, the polar ion 8 of minus is controlled by the screen electrode 2, and it is made to collide with the latent-image support 7 through opening 3, as shown in (b) of drawing 22 .

[0007] Said latent-image support 7 is used as the so-called dielectric drum 11 on which the desired dielectric layer 10 was formed in the front face of the metal drum 9 as shown in (b) of drawing 22 , and said metal drum 9 is grounded. And as mentioned above, the electrostatic latent image corresponding to the image of the request which is not illustrated is formed in the front face of the dielectric drum 11 by making the polar ion 8 of minus as a charged particle collide with the front face of the dielectric drum 11.

[0008] The conventional ion write head 1b of other examples is shown, in this conventional ion write head 1b, corotron 12 is used for generating of the ion 8 as a charged particle, the control electrodes 14 and 14 of two sheets which have two or more desired openings 13 in that front face are arranged, and drawing 23 is driven by the proper actuation circuit 15. And it is controlled whether the ion 8 8 generated in corotron 12, for example, the ion of a plus polarity, makes it reach from opening 13 to the latent-image support 7 with the polarity of the electrical potential difference applied among the control electrodes 14 and 14 of two sheets. Moreover, distance between the control electrodes 14 and 14 of two sheets is set to about 100 micrometers, and the diameter of opening 13 is set to about 200 micrometers. Furthermore, resolution of ion write head 1b is carried out in about 8 dots/mm. Moreover, said opening 13 is arranged by serrate like the opening 3 of head 1a shown in (a) of drawing 22 mentioned above.

[0009]

[Problem(s) to be Solved by the Invention] However, in the conventional ion write head 1 (a sign names generically the conventional ion write heads 1a and 1b) mentioned above, since it is impossible to make latent-image formation generate the ion 8 of only a complement on real time, a lot of ion 8 is always generated, the part is drawn on the latent-image support 7 by the screen electrode 2 or the control electrode 14 of two sheets, and 14 grades, and an electrostatic latent image is formed. For this reason, the utilization effectiveness of the generated ion 8 was low, and there were various troubles of processing of the ozone generated simultaneously with ion 8, buildup of power consumption, enlargement of a head 1, enlargement, formation of an expensive rank of the actuation circuit 15 for control electrodes that controls high tension, etc.

[0010] Moreover, in the conventional ion write head 1, there was a trouble that the minimum of the magnitude of the openings 3 and 13 which ion 8 passes had constraint. One of the constraint of this is for enlarging utilization effectiveness of the generated ion 8, I hear that another must make the process tolerance and isolation voltage of the screen electrode 2 which impresses high tension, or a control electrode 14 hold, and there is.

[0011] That is, the trouble of using the screen electrode 2 or control electrode 14 which has the big openings 3 and 13 is a point that the diameter of 1 dot of the electrostatic latent image formed when the point that the absolute value of control voltage becomes large, and the ion 8 (ionic current) which flows toward the latent-image support 7 from the ion write head 1 are extracted does not become small enough. In extracting an ionic current, the diameter of an ionic current converges on about [ of the diameter of the openings 3 and 13 of control electrodes 2 and 14 / 1/several ] for the electrical potential difference which joins electrodes 2 and 14. For this reason, the diameter of 1 dot of the electrostatic latent image formed becomes small compared with an increase or the case where it carries out, about an ionic current. However, the potential of the electrostatic latent image at the time of extracting an ionic current for the limitation of the rate of focusing serves as an in-between value, and will reproduce halftone with potential.

[0012] Moreover, although the repeatability in the case of area gradation is good when reproducing concentration gradation with the coating weight of a toner, the repeatability in the case of concentration gradation does not have so good repeatability by factors, such as dispersion in the amount of electrifications of a toner. Generally, it is said that the conventional ion write head 1 is excellent in the

repeatability of concentration gradation compared with other write-in methods. Although the repeatability and stability of gradation in case many flow rates of ion 8 go into the field of area gradation are excellent if it sees strictly about this repeatability, the tone reproduction at the time of extracting the flow rate of ion 8 is inferior compared with the high concentration field. And when not changing but reproducing gradation by change of potential, there cannot but be many factors which degrade the grace of images, such as dispersion in the coating weight of a toner, at a development process, and the area of an electrostatic latent image cannot but become what was inferior to the tone reproduction in area gradation as a result, even if formation of an electrostatic latent image is performed to accuracy to an input signal.

[0013] That magnitude of said openings 3 and 13 cannot be made small has the trouble of the constraint on the design of not comparing openings 3 and 13 with the ability of resolution not being raised on a straight line.

[0014] Generally, although the quality of printed character of fixed level can be obtained to the repeatability of the binary picture of white and black also in the printer of an electrophotography method, the repeatability of an image including halftone is not good. Then, in a current electrophotography method, the approach of reproducing halftone in false is in use with the area gradation using a dither, and the resolution of printing at the time of using a dither falls substantially compared with the resolution in electrostatic latent-image means forming.

[0015] The matrix of a typical dither is formed by 4x4 pixels or about 6x6 pixels. The tone reproduction in that case becomes 16 steps and 36 steps, and the resolution of the image formed is set to 1/4 or 1/6. When thinking a tone reproduction as important, in order to obtain practical resolution, it is necessary to form an electrostatic latent image with dramatically high resolution.

[0016] In the printer using the conventional ion write head 1, since the repeatability of halftone is excellent, the rendering of concentration gradation is possible also for not depending on a dither, either. Therefore, it has been thought that the trouble that resolution cannot be raised because of a limit of the magnitude of openings 3 and 13 etc. is suppliable with the repeatability of concentration gradation. That is, in the application over which priority is given to a tone reproduction like a photograph, even if resolution was low, when the tone reproduction was excellent, repeatability was suppliable, but in the application as which high resolution, such as printing of an alphabetic character, is required, though some improvements could be made using the tone reproduction, there was a trouble that only the quality of printed character which was substantially inferior to the electrophotography method with high resolution was obtained.

[0017] Moreover, it sets to the conventional ion write head 1. Two or more openings 3 and 13 cannot be formed in the print width direction in a straight line. Two or more openings 3 and 13 were arranged aslant, and when the method which forms the electrostatic latent image of one line in time sharing was used, the nonuniformity of a rate was in the latent-image support 7 or the timing of writing shifted to it, there was a trouble that the location of an electrostatic latent image shifted and a quality of printed character deteriorated substantially. Moreover, a control circuit, the actuation circuit 15, etc. which are not illustrated tended to become complicated and expensive by rearrangement of an image, generating of timing, etc., ion write head 1 the very thing was enlarged, and there was a trouble that it became difficult to keep constant the distance between the ion write head 1 and the latent-image support 7.

[0018] This invention is made in view of these points, and the trouble in the conventional thing mentioned above is conquered, and it is small and aims at offering the ion write head with the high utilization effectiveness of ion.

[0019]

[Means for Solving the Problem] In order to attain the object mentioned above the ion write head of this invention according to claim 1 Two or more individual electrodes which are the ion write head which a charged particle is made to adhere selectively and forms an electrostatic latent image on the latent-image support constituted with a dielectric, and were formed on the substrate, The electron emission section which may emit the electron for generating a charged particle by being formed on said individual electrode and heated, It is characterized by having a heating unit for heating said electron emission



section, and a gate electrode for accelerating the electron which collaborated with said individual electrode and was emitted from said electron emission section.

[0020] And the ion write head of this invention according to claim 2 is characterized by said individual electrode making said heating unit serve a double purpose in claim 1.

[0021] Furthermore, the ion write head of this invention according to claim 3 is characterized by forming said electron emission section considering a ferroelectric as a subject in claim 1 or claim 2.

[0022] Moreover, the ion write head of this invention according to claim 4 is characterized by having the actuation circuit which makes said heating unit generate heat to predetermined timing in any 1 term of claim 1 thru/or claim 3.

[0023]

[Function] The ion write head of this invention which consists of a configuration mentioned above By generating ion using the so-called principle of thermionic emission, and heating the heating unit formed on the substrate Heat the electron emission section, make a thermoelectron emit from here, accelerate by the electric field to which this electron is impressed between the gate electrode and the individual electrode, and ion is generated. It can be made to be able to move to the front face of latent-image support by the electric field to which this ion is impressed between an individual electrode and latent-image support, and an electrostatic latent image can be formed in the front face of latent-image support.

[0024]

[Example] Hereafter, the example which shows this invention to a drawing explains.

[0025] Drawing 3 shows the 1st example of the ion write head concerning this invention from drawing 1, drawing 1 is drawing of longitudinal section showing the configuration of an important section, it is a cutting top view a part and drawing 2 is a circuit diagram showing the configuration of an important section in which drawing 3 shows an actuation circuit.

[0026] As shown in drawing 1 and drawing 2, the heat insulating layer 18 is arranged on the substrate 17, and, as for the ion write head 16 of this example, the heater layer 19 is arranged in the top face of this heat insulating layer 18. And it is called two or more cathode electrodes which corresponded to resolution (pixel number) through the medium insulating layer 20 on the top face of the heater layer 19, for example, alignment arrangement of the individual electrode 21 which has the base 77 with a diameter of about 30 micrometers is carried out in drawing at the longitudinal direction (the print width direction) at the shape of a single tier. Furthermore, the electron emission section 22 which may emit the electron for generating a charged particle (ion) is arranged in the top face of the base 77 of the electrode 21 according to each. Moreover, the conductive layer 23 for centralizing generation of heat of the heater layer 19 to each electron emission section 22 is arranged in the top face of the heater layer 19 except for the part which counters each electron emission section 22. That is, let the part which is not covered with the conductive layer 23 corresponding to each electron emission section 22 of the heater layer 19 be the heating unit 24 for heating each electron emission section 22 in this example. On a substrate 17, it centered on each electron emission section 22, for example, the gate electrode 26 which has the circular opening 25 with a diameter of about 20 micrometers is arranged through the insulating layer 27 of proper thickness further again, and it is formed in abbreviation plate-like as a whole.

[0027] that in which thermal resistance is high and has required mechanical strength and workability as a raw material of said substrate 17 -- it is -- it is -- \*\*\*ing -- insulating materials and front faces, such as an alumina ceramic and glass, -- SiO<sub>2</sub> etc. -- various things, such as a silicon substrate which carried out the clad with the insulating material, can be chosen.

[0028] As a raw material of said heat insulating layer 18, various things, such as high-melting glass with the small heat conductivity, foam glass, a zirconia ceramic, and a silicon dioxide, can be chosen.

[0029] As a raw material of said heater layer 19, various things, such as a tungsten, Nichrome, and tantalum nitride, can be chosen.

[0030] since big electric field are put to the ion added and generated as a raw material of said medium insulating layer 20 -- SiO<sub>2</sub> with high insulation performance and stability, and Al<sub>2</sub>O<sub>3</sub> etc. -- it is desirable to use the insulating material of an inorganic substance.

[0031] It is desirable to use metal raw materials, such as platinum, a tungsten, a tantalum, and

molybdenum, in consideration of conductivity and workability as a raw material of said individual electrode 21.

[0032] the ferroelectric which has the thermionic-emission operation which emits an electron with heating as a raw material of said electron emission section 22, for example, barium titanate, strontium titanate, zirconic acid barium, zirconic acid strontium, etc. can be illustrated, and independent [ if needed ] in these -- or it can combine and use.

[0033] As a raw material of said conductive layer 23, it has small electric conductivity and platinum high to thermal resistance, a tantalum, a tungsten, molybdenum, etc. are more desirable than the heater layer 19.

[0034] Various things, such as molybdenum and a tantalum, can be chosen as a raw material of said gate electrode 26.

[0035] since heat is added while big electric field are put to the ion added and generated as a raw material of said insulating layer 27 -- transparence with high insulation performance and stability with little heat loss or white SiO<sub>2</sub>, and Al<sub>2</sub>O<sub>3</sub> etc. -- it is desirable to use the insulating material of an inorganic substance.

[0036] Moreover, as a fictitious outline shows to drawing 1, the latent-image support 28 in which an electrostatic latent image is formed as the gate electrode 26 of said ion write head 16 is countered is arranged. While the proper dielectric layer 30 is formed in the front face of the desired metal base 29, this latent-image support 28 The fixed distance G of about 100 micrometers (gap) is separated from said gate electrode 26, it is arranged, and migration is made free with constant speed in the direction of vertical scanning which intersects perpendicularly to the main scanning direction where said each electron emission section 22 is arranged.

[0037] As shown in drawing 3, the reference potential is formed when the actuation circuit 31 of the ion write head 16 of this example grounds the metal base 29 prepared in the opposite hand to the ion write head 16 of the latent-image support 28 as a back plate 32. While connecting electrically, let the power source VL for latent-image writing to which this actuation circuit 31 supplies the polar electrical potential difference of minus to the gate electrode 26 be a common electrode [ as opposed to the electrode 21 according to each in the gate electrode 26 ]. And each actuation transistor 33 makes the gate electrode 26 a reference potential, and the electrode 21 according to each is connected to the power source VE for electronic acceleration which impresses the polar electrical potential difference of minus to the gate electrode 26 through the current setting-out resistance 34 while connecting with the respectively proper actuation transistor 33. Moreover, the power source VH for heating is electrically connected to the heater layer 19 through the temperature control section which is not illustrated for always controlling the exoergic temperature of a heating unit 24 to fixed temperature. In addition, as for the energization of the power source VH for heating to the heater layer 19, it is desirable to control by the pulse voltage which synchronized with formation of the electrostatic latent image of each pixel based on a control command.

[0038] If said actuation circuit 31 is explained further, the actuation circuit 31 of this example will be constituted by the current regulator circuit, and the current of this current regulator circuit will be determined as the current setting-out resistance 34 connected to the emitter of each actuation transistor 33 with the electrical potential difference applied to the base of each actuation transistor 33. And the base electrical potential difference of each actuation transistor 33 is impressed by inputting the digital signal by which weighting was carried out through the D/A conversion circuit 35 which combined resistance with the ladder mold. Furthermore, the input signal over the ion write head 16 is made into the serial signal 36 in which each has another weight, and is changed into a parallel signal by the shift register 37 corresponding to each serial signal 36. Moreover, once this parallel signal is held at latch 38, it is outputted to a gate circuit 40 by the latch signal 39, takes ANDO with a strobe signal 41 by the gate circuit 40, and is inputted into the D/A conversion circuit 35. This strobe signal 41 is a signal which determines the operating time over the gate electrode 26 of the individual electrode 21.

[0039] That is, the electrode 21 according to each in this example is electrically connected to the actuation circuit which is insulated separately and has a constant current characteristic, and the heater



layer 19 has connected each heating unit 24 to a serial.

[0040] In addition, power is reducible by considering as the configuration which divides the heater layer 19 and is made into two or more groups.

[0041] Below, (j) explains the production process of the ion write head 1 of this example from (a) of drawing 4.

[0042] First, sequential membrane formation of the heat insulating layer 18 which becomes the top face of the abbreviation plate-like proper substrate 17 which consists of insulating materials, such as glass, from a silicon dioxide, the heater layer 19 which consists of tantalum nitride, and the conductive layer 23 which consists of a tantalum is carried out using the well-known thin film formation approach. And etching etc. removes the position of the heater layer 19 and a conductive layer 23 in the same configuration, and as shown in (a) of drawing 4, and (b), the heater layer 19 and a conductive layer 23 are formed in a predetermined configuration. Subsequently, as etching etc. removes the position of a conductive layer 23 and it is shown in (c) of drawing 4, and (d), the predetermined part of the heater layer 19 is exposed and a predetermined number corresponding to the number of pixels of heating units 24 are formed. the next -- SiO<sub>2</sub> from -- after forming the becoming medium insulating layer 20 similarly using the well-known thin film formation approach, as shown in (e) of drawing 4, and (f), only the predetermined number corresponding to the number of pixels forms the individual electrode 21 which consists of metals, such as a tantalum, using the well-known thin film formation approach and well-known etching. the next -- SiO<sub>2</sub> from -- as the becoming insulating layer 27 and the gate electrode 26 which consists of metals, such as a tantalum, are similarly shown in (g) of drawing 4, and (h) after \*\*\*\*\* one by one, etching etc. removes the position of the gate electrode 26 and the opening 25 of desired magnitude is formed. Subsequently, etching etc. removes the position of an insulating layer 27, and as shown in (i) of drawing 4, the individual electrode 21 located under the opening 25 is exposed. By carrying out migration electrodeposition of the electrodeposited liquid which contains a ferroelectric on the individual electrode 21 next, and forming an electrodeposited film, the electron emission section 22 is formed and manufacture of the ion write head is completed. In addition, when forming the electron emission section 22, after forming the proper mold release layer (not shown) by the photoresist etc. on the gate electrode 26 at the process and forming the electron emission section 26 before forming the electron emission section 22, it is good to remove a mold release layer.

[0043] Below, it explains in more detail about formation of the electron emission section 22 of the ion write head 16 of this example.

[0044] In order to form the electron emission section 22 of this example, the electrodeposited liquid which uses a ferroelectric as a principal component is formed first. This electrodeposited liquid grinds the ferroelectric powder of perovskite molds, such as barium titanate, to particle-size extent of 1 micrometer or less with wet grinding, washes it with pure water, and removes impurities, such as a barium hydroxide. Next, 1% (wt%) of pure water as an electrolyte and 0.0012% (wt%) of calcium chlorides are added to a methanol, and the electrolytic solution is formed. Next, electrodeposited liquid is formed by adding the powder of a ferroelectric compound to said electrolytic solution 0.15%. PH of this electrodeposited liquid is a little less than seven, and conductivity is 30microS/cm extent. Although the ferroelectric compound itself is chemically stable and the solubility to water is small at this time, oxides, such as unreacted barium and titanium, react with water, turn into a hydroxide, and dissolve in water, and in order to reduce the resistivity of electrodeposited liquid, it is necessary to remove them beforehand. Moreover, in electrodeposited liquid, the calcium chloride in the electrolytic solution is ionized in calcium ion and a chloride ion, and is incorporated as a calcium hydroxide in the electrodeposited film formed. Subsequently, after stirring electrodeposited liquid, by putting for several hours, a ferroelectric compound with a large particle size is made to sediment, it removes, and manufacture of electrodeposited liquid is completed.

[0045] An electrodeposited film is formed on [ classified by each ] an electrode 21 by using the individual electrode 21 of the ion write head 16 as cathode, applying an about [ 50V ] electrical potential difference using the platinum which is hard to ionize to an anode plate, and next, performing migration electrodeposition. The current density at the time of this migration electrodeposition is 2 70mA/cm.

Extent and an electrodeposition rate are good to consider as 1 micrometer/min extent.

[0046] The electron emission section 22 is formed on [ classified by each ] an electrode 21 by performing heat treatment heated at about 200-300 degrees C in atmospheric air for several hours next, removing a methanol, and heating in atmospheric air or a vacuum at the temperature of about 600 degrees C after that for several hours. In addition, the calcium hydroxide incorporated in the electrodeposited film reacts with the carbon dioxide in atmospheric air by heat treatment, a part serves as a calcium carbonate, the remainder serves as a calcium oxide, and these lime compounds carry out the duty of cement which hardens between the fine particles of a ferroelectric (ferroelectric compound), and make firm the electrodeposited film used as the electron emission section 22 formed on [ classified by each ] the electrode 21.

[0047] Next, the ion write head 16 of this example was put into the vacuum tub, the electron emission section 22 was heated, and the amount of electron emission (emission) was evaluated. Whenever [ stoving temperature ] was gradually made high and the process which emission increases from a minute current field was recorded. The emission to each temperature is the same level as the thermionic-emission raw material of the oxide covering form of common barium or calcium, and has checked that a work function was almost equal. Moreover, when it was made to operate at the temperature for several hours, it has checked that the property was stable.

[0048] Subsequently, when the pressure of a vacuum tub was gradually made high toward the atmospheric pressure condition from the vacua and the property in the inside of atmospheric pressure was evaluated eventually, it became clear by enlarging the electric field between the individual electrode 21 and the gate electrode 26 that an electron could be efficiently emitted from the electron emission section 22. And the current which can be taken out from the electron emission section 22 was proportional to the electric field between the individual electrode 21 and the gate electrode 26, and while having a relation in inverse proportion to a distance in the meantime, it became clear that the current which can be taken out in atmospheric air was 1/100 to about 1/1000 as compared with the case in a vacuum.

[0049] Below, an operation of the ion write head 16 mentioned above is explained.

[0050] If the ion write head 16 of this example is made to drive and the current of the power source VH for heating is energized in the heater layer 19, the heating unit 24 formed in the heater layer 19 will generate heat, and generation of heat of this heating unit 24 will heat the individual electrode 21 and the electron emission section 22 to predetermined temperature. And the heated electron emission section 22 emits an electron (thermoelectron) to the space of the outside of the electron emission section 22 by the principle of thermionic emission.

[0051] The electron emitted to the space of the outside of said electron emission section 22 is caught by the oxygen molecule in the space between the gate electrode 26 and the latent-image support 28, after being accelerated by the electric field formed of the electrical potential difference of the power source VE for electronic acceleration impressed between the individual electrode 21 and the gate electrode 26, and it becomes oxygen ion, and the polar ion (not shown) of minus as a charged particle is generated. This ion moves toward the front face of the latent-image support 28 by the electric field which are impressed between the gate electrode 26 and the back plate 32 of the latent-image support 28, and are formed of the electrical potential difference of the power source VL for slack latent-image writing.

[0052] Moreover, the ion write head 16 of this example The electrode 21 according to each is formed in the shape of a single tier using a certain thin film formation approach, etching, etc. from the former. While being formed by making the upper part electrodeposit the electron emission section 22 and being able to form easily the electrode 21 according to each and the electron emission section 22 of complicated and detailed structure It can form in the shape of a line, and the resolution of the ion write head 16 can be raised easily.

[0053] Below, generation of ion and migration of ion are explained.

[0054] In this example, the gap G between the gate electrode 26 and the latent-image support 28 is set to 100 micrometers, potential of the gate electrode 26 is set to -500--600V to the back plate 32 of the latent-image support 28, and the electric field between the gate electrode 26 and the latent-image support



28 are carried out [ mm ] in 5-6kV /. The value of this electric field is a value of one half extent of the sparkover voltage in the atmospheric air in the gap G between the gate electrode 26 and the latent-image support 28.

[0055] Moreover, when an electron is made to emit into atmospheric air by heating the electron emission section 22 The mean free path of the oxygen molecule in about 400nm and atmospheric air of the mean free path of the electron in the inside of the air of atmospheric pressure is 64nm. The emitted electron is 103-104, while carrying out the drift of the between with a gap [ G ] of 100 micrometers. It collides with the gas molecule in time atmospheric air, it is caught by an oxygen molecule and the molecule of a steam probable, and the polar ion (O<sub>2</sub>-ion) of minus as a charged particle is generated. At this time, about by 2x10 to four, where ion and an electron are mixed, the probability for the electron of low energy to be caught by the oxygen molecule serves as an ionic current, arrives at the front face of the latent-image support 28, and it gives the polar charge of minus to the front face of the latent-image support 28, and the polar detailed electrostatic latent image of minus is formed in the front face of the latent-image support 28. That is, surface potential of the latent-image support 28 of an initial state (before an electrostatic latent image is written in) is set to 0V by electric discharge, and the electrostatic latent image of the potential which is proportional to the amount of attainment of the polar ion of minus of an electron on reception and its front face from the polar ion of the minus which arrived at the front face of the latent-image support 28 is formed. Since the ion and electron which arrive at the front face of the latent-image support 28 at this time move to line of electric force at parallel, that breadth can be disregarded until electrostatic latent-image potential is saturated. The maximum of the potential of this electrostatic latent image is saturated with the value near the electrical potential difference of the power source VL for latent-image writing.

[0056] Therefore, the polar ion of the minus which arrived at the front face of the latent-image support 28 after the potential of an electrostatic latent image was saturated moves to the one where latent-image potential is smaller along the front face of the latent-image support 28, and gives a charge to the front face of the part. That is, the electrostatic latent image on the latent-image support 28 will spread in concentric circular. The breadth of this electrostatic latent image decreases, so that the gap G between the gate electrode 26 and the latent-image support 28 is short.

[0057] The mass of said ion is 5.9x10<sup>4</sup> of an electron. It is about twice, and passing speed of the ion by the electric field between said gate electrodes 26 and back plates 32 of the latent-image support 28 is made into 100 m/S extent, and the transit time of the ion between said gaps G of 100 micrometers becomes about [ 1micro ] S.

[0058] Here, the time amount which the magnitude of one pixel (dot) will be about 84.67-micrometer angle, and the writing of one line will take the resolution of image formation if passing speed (process rate) of 300DPI and the latent-image support 28 is made into 100 mm/S is set to 847microS, and since the passing speed of ion is fully shorter than the write time of one line, it does not become the failure of the writing of an electrostatic latent image.

[0059] Moreover, when there is little emission from the electron emission section 22, the ionic current which the electrical potential difference of the gate electrode 26 is subtracted to the potential of the electron emission section 22, and the potential of the part near the opening 25 of the space around the electron emission section 22 is subtracted, and becomes from ion and an electron is converged on the core of the opening 25 of the gate electrode 26. The convergence rate of the ionic current to the opening 25 of this gate electrode 26 becomes about 3 times at the maximum.

[0060] that is, the amount of the ion which concentrates the magnitude of the electrostatic latent image formed on the latent-image support 28 on the small diameter which line of electric force reaches when there are few amounts of the polar ion of the minus which arrives at the front face of the latent-image support 28, and reaches -- increasing -- \*\* -- the polar potential of minus of the electrostatic latent image which is not rises, and the line of electric force which arrives at the front face of the latent-image support 28 spreads. The area of a breadth electrostatic latent image will be expanded to concentric circular by the polar ion of the minus which takes and reaches it on the front face of the latent-image support 28.

[0061] Therefore, linearity of the area of the electrostatic latent image over the amount of the generated



ion can be made very high.

[0062] [ when developing an electrostatic latent image with a toner and considering as a toner image ] namely, the linearity of the coating weight of a toner By the case where the area of the electrostatic latent image of the case where the potential of an electrostatic latent image has halftone, and fixed potential changes Since area gradation can form the electrostatic latent image of a detailed area also in a low printing concentration field and printing by wide range area gradation is attained, the ion write head 16 of this example The high-definition quality of printed character in which the repeatability of gradation was extremely excellent compared with the conventional ion write heads 1 and 1a can be obtained. This quality of printed character is excellent also to the quality of printed character of an electrophotography method which has the high resolution used for the application as which high resolution, such as printing of an alphabetic character, is required.

[0063] Amplification of the area of said electrostatic latent image does not necessarily break out indefinitely, and is restricted to the fixed range according to the amount of the ion which reaches by the electric field impressed between the gate electrode 26 and the back plate 32 of the latent-image support 28. Moreover, the potential of the electrostatic latent image formed is also restricted to the almost fixed value near the electrical potential difference impressed between the gate electrode 26 and the back plate 32 of the latent-image support 28.

[0064] Although the gap G between said gate electrodes 26 and latent-image support 28 is restricted by the precision of the gap G between the gate electrode 26 at the time of making it run the danger and the latent-image support 28 of the short circuit by trespass of a toner, and the latent-image support 28, as for the gap G between the gate electrode 26 and the latent-image support 28, it is desirable to constitute so that the distance G of abbreviation regularity may always be held.

[0065] In addition, since it collides with the front face of the gate electrode 26 with which the polar ion of the plus which exists in atmospheric air is formed in the front face of the ion write head 16 of the electric field between the gate electrode 26 and the latent-image support 28, and potential is [ area ] large subtracted most, the probability which carries out the spatter of the electron emission section 22, and is exhausted is very small, and the electron emission section 22 can hold the function continued and stabilized at the long period of time.

[0066] Moreover, since the rate which ion moves is proportional to the magnitude of electric field, it is desirable to consider as high electric field within limits which do not carry out dielectric breakdown.

[0067] Below, a current required for electrostatic latent-image formation is explained.

[0068] The potential of the electrostatic latent image formed in the front face of said latent-image support 28 is decided by the ratio of the electrostatic capacity of the dielectric layer 30 of the ion or electronic charge which reaches the latent-image support 28, and the latent-image support 28. Here, when thickness of the dielectric layer 30 of the latent-image support 28 is set to 20 micrometers and the dielectric constant is set to 2.5, it is 2.1 cm. The electrostatic capacity of a hit is set to 110.7 pF. The charges taken to electrify the dielectric layer 30 of this latent-image support 28 from 0V to -500V are 55.35 nC(s). When width of face of the image recording of the latent-image support 28 is made to 210 mm and a process rate is made into 100 mm/s, a current required of the ion write head 16 whole is 11.62 microA. The number of pixels at the time of setting the die length of the printing section to 210 mm becomes 2480 pieces in 300 DPI, becomes 3307 pieces in 400 DPI, and the average current per electrode 21 according to each serves as 4.69 nA(s) in 300 DPI, and it serves as 3.51 nA(s) in 400 DPI.

[0069] When magnitude of said individual electrode 21 is made into the diameter of 30 micrometers, the area is  $7.07 \times 10^{-6}$  cm<sup>2</sup>. Current density is 497 microA/cm<sup>2</sup> in 663 microA/cm<sup>2</sup> and 400 DPI at 300 DPI. It becomes. And 100 mA/cm<sup>2</sup> in the case of operating the individual electrode 21 in a vacuum in respect of current density Although it is quite small, it is equivalent level when it takes that ion or electrons are scattered about in atmospheric air, and mobility falls into consideration. The magnitude of this individual electrode 21 is restricted by current density and the dimensional accuracy by the processing technique.

[0070] Below, the tone reproduction at the time of using a liquid phenomenon is explained.

[0071] As for the tone reproduction at the time of using a liquid phenomenon, the resolution of the ion

write head 16 serves as a determinant. The diameter of 30 micrometers and the gate electrode 26 is set to 20 micrometers for the diameter of the individual electrode 21, the minimum of the magnitude of an electrostatic latent image is set to 7 micrometers, the upper limit of the magnitude of an electrostatic latent image serves as 84.67-micrometer angle in 300DPI, and the ion write head 16 in this example serves as 63.5-micrometer angle in 400DPI. And dot area in case the diameter of an electrostatic latent image is 7 micrometers is 2 38.5 micrometers. Becoming, an area of 1 pixel of each resolution is 2 4032 micrometers in 2 and 400DPI 7069 micrometers at 300DPI. It becomes, and it can become 183.6 times in 300DPI, it can become 104.7 times in 400DPI, and surface ratio can be made without a dither into outline 128 gradation (7 bits) extent. Furthermore, each color 256 gradation (8 bits) 1,670,000 color specification is possible by the dither of a 2-4-pixel unit.

[0072] Below, the tone reproduction of a using-dry developing case is explained.

[0073] As for the tone reproduction at the time of using dry developing, the particle size of a toner serves as a determinant. Whenever [ by the current grinding method / high image ], a typical particle size of a toner is about 7 micrometers, and the minimum of the magnitude of an electrostatic latent image is set to about 14 micrometers. The dot area in this case is 2 153.9 micrometers. The surface ratio of an electrostatic latent image becomes 45.9 times in 300DPI, and becomes 26.2 times in 400DPI, and processing of a dither becomes unnecessary when the printing concentration of each pixel is larger than the minimum value determined by the above-mentioned surface ratio, since the linearity of the magnitude of an electrostatic latent image is high. Moreover, when printing concentration is smaller than the minimum value of the above-mentioned surface ratio, in order to obtain a gradation rendering with a color [ each ] of 8 bits, it is good to use the dither of 9 dots of 3x3, and the matrix of the 16-dot unit of 4x4.

[0074] Below, the resolution in ion writing is explained.

[0075] According to the printer using the ion write head 16 of this example, it can reappear without 8-bit (256 gradation's) a total of 1,670,000 colors' almost using a dither for three primary colors respectively, and resolution of an image can be made into the level near a photograph or a sublimation mold.

[0076] In the case of the image of the bit map of a color, there will be few pixels of a great portion of data because of a limit of amount of information than the number of pixels of the image constituted by the ion write head 16, and it will expand with software, and will print. As the typical number of pixels, 640 dots wide, the length of 480 dots, and the amount of information of 24 bits (1,670,000 colors) become 900 K bytes, when not compressing data. The resolution in the case of printing the image in 8cm wide and 6cm long magnitude is set to mm in 8 dots (about 200 DPI) /. It is possible to acquire the 300 - 400DPI \*\*\*\*\* as the usual page printer with the same resolution and repeatability faithful except when printing an image with high resolution specially.

[0077] Moreover, according to the printer using the ion write head 16 of this example, although overwhelmingly excelled to the electrophotography method etc. in the repeatability of concentration gradation, in printing of an alphabetic character without gradation, the resolution of a print head becomes the factor which determines image quality. Although the resolution of the direction (main scanning direction) where the pixel of the line head as a print head is located in a line is decided by resolution of a print head The number of the individual electrodes 21 used as the number of the pixels in the ion write head 16 of this example It is easy to make it subdivide to the direction (the direction of vertical scanning) to which the latent-image support 28 or a printing medium moves (increment). In printing of an alphabetic character, the notch of the edge of the printed alphabetic character can be made smooth by making the number of the individual electrodes 21 in the ion write head 16 increase, and making resolution high.

[0078] Therefore, while the ion write head 16 of this example can make electrostatic latent-image formation generate the ion of only a complement on real time unlike the conventional ion write heads 1 and 1a by the corona discharge and high frequency discharge using high tension, integration of the actuation circuit 31 becomes easy, and while the price can miniaturize and fall certainly, resolution can be raised certainly.

[0079] Drawing 8 shows the 2nd example of the ion write head concerning this invention from drawing



5 , drawing 5 is drawing of longitudinal section showing the configuration of an important section, drawing 6 is a gate electrode and the top view which excluded the insulating layer, drawing 7 is the sectional side elevation of drawing 6 , and drawing 8 is the circuit diagram showing an actuation circuit. [0080] Ion write head 16a of this example is taken as the configuration which carried out grouping of the individual electrode 21 while the individual electrode 21 of said 1st example serves as the function of the heater layer 19.

[0081] As shown in drawing 5 , the heating individual electrode layer 42 of the predetermined configuration for making the heater layer 19 and the individual electrode 21 of the 1st example which the heat insulating layer 18 is arranged on the substrate 17, and mentioned above ion write head 16a of this example in the top face of this heat insulating layer 18 serve a double purpose is arranged. And the conductive layer 23 is arranged in the top face of the heating individual electrode layer 42. Furthermore, the heating individual electrode layer 42 and the conductive layer 23 are etched into the same predetermined configuration. Moreover, the position of the conductive layer 23 on the heating individual electrode layer 42 is removed by etching etc., and, thereby, the heating unit 24 on which generation of heat of the heating individual electrode layer 42 is centralized to the electron emission section 22, and individual electrode 21a called the cathode electrode corresponding to resolution (pixel number) are formed. This individual electrode 21a is made into magnitude with a diameter of about 30 micrometers, and as shown in drawing 5 and drawing 6 , alignment arrangement is carried out at the longitudinal direction (the print width direction) at the shape of a single tier. And the electron emission section 22 which may emit the electron for generating a charged particle (ion) is arranged in the top face of electrode 21 according to each a. Moreover, on the heat insulating layer 18, it centered on each electron emission section 22, for example, the gate electrode 26 which has the circular opening 25 with a diameter of about 20 micrometers is arranged through the insulating layer 27 of proper thickness, and it is formed in abbreviation plate-like as a whole.

[0082] As a raw material of said heating individual electrode layer 42, platinum, a tantalum, molybdenum, a tungsten, etc. are suitable.

[0083] That is, in ion write head 16a of this example, while the part which is not covered with the conductive layer 23 of the heating individual electrode layer 42 is set to individual electrode 21a, it is set to heating unit 24a for heating each electron emission section 22, and it has the composition that the electron emission section 22 is directly formed on individual electrode 21a. Moreover, as shown in drawing 6 , grouping of the heating individual electrode layer 42 in this example is carried out so that four individual electrode 21a may become 1 set. It is not especially limited to the number of individual electrode 21a of this example that what is necessary is for resolution, a design concept, etc. of ion write head 16a just to determine the number of individual electrode 21a in this 1 group.

[0084] As shown in drawing 8 , actuation circuit 31 of ion write head 16a of this example a is constituted so that time sharing of the electrode 21 according to each a may be carried out and it may be heated, and the power source VH for heating is connected to electrode 21 according to each a through the DC/DC conversion circuit 43 of an insulating mold, and the heater change-over circuit 44 as a switch for the on/off of every electrode 21 according to each a. And the heater change-over signal 46 which carries out on/off of the heater change-over circuit 44 through the photo coupler 45 corresponding to electrode 21 according to each a is inputted into the heater change-over circuit 44. Other configurations are the same as that of the actuation circuit 31 of the 1st example mentioned above.

[0085] By considering as such a configuration, this example By considering as the configuration which forms the electronic radiator 22 directly on individual electrode 21a which served as the heating unit 24, while doing so the same effectiveness as the 1st example mentioned above While a production process can be simplified, being able to reduce the number of production processes and being able to reduce an economic burden certainly Since a miniaturization can be attained and (the amount of accumulation) can be made small for heat capacity, the responsibility over a temperature change can be raised and heating time for the electron emission section 22 to emit an electron can be shortened. Moreover, since the medium insulating layer 20 in the 1st example can be excluded, there is no temperature gradient and the utilization effectiveness of heat can be raised certainly.



[0086] Drawing 11 is the top view showing the configuration of the important section which excluded the gate electrode and the insulating layer, drawing 13 shows the 3rd example of the ion write head concerning this invention from drawing 9, drawing 9 is drawing of longitudinal section showing the configuration of an important section, drawing 10 is the top view of drawing 9, and drawing 13 is [ drawing 12 is the sectional side elevation of drawing 11, and ] the circuit diagram showing an actuation circuit.

[0087] Ion write head 16b of this example is taken as the configuration which divided the gate electrode 26 so that it might correspond to electrode 21 according to each a of said 2nd example.

[0088] Gate electrode 26a divided by the insulating layer 27 is arranged, and as shown in drawing 12 from drawing 9, ion write head 16b of this example is formed so that the configuration of the heating individual electrode layer 42 may also correspond to gate electrode 26a, so that it may correspond to electrode 21 according to each a formed in the heating individual electrode layer 42. Other configurations are the same as that of ion write head 16a of the 2nd example mentioned above.

[0089] As shown in drawing 13, while time sharing of the actuation circuit 31 of ion write head 16b of this example b is carried out and it heats each gate electrode 26a, it is constituted so that electrode 21 according to each a may be heated for every group, and the power source VL for latent-image writing is connected to each gate electrode 26a through the gate change-over circuit 47 as a switch for the on/off of each gate electrode 26a of every. He is trying for this gate change-over circuit 47 to operate with the gate change-over signal 48. Moreover, the power source VH for heating is connected to individual electrode 21a by which grouping was carried out per four pieces through the DC/DC conversion circuit 43 of an insulating mold. Other configurations are the same as that of actuation circuit 31a of the 2nd example mentioned above.

[0090] This example can do so the same effectiveness as the 2nd example mentioned above by considering as such a configuration.

[0091] Below, drawing 18 explains the structure of holding uniformly the distance G of the gate electrode 26A (a sign names generically the gate electrodes 26 and 26a) and the latent-image support 28 of each ion write head 16A (a sign names generically the ion write heads 16, 16a, and 16b) of this example, from drawing 14.

[0092] Drawing 14 shows the 1st example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support.

[0093] This example uses for a front face the dielectric drum 49 which has a dielectric layer 30 as latent-image support 28.

[0094] In this example, the proper contact rollers 50 and 50 are arranged in the both ends of the longitudinal direction which is the print width direction of ion write head 16A, and the dielectric drum 49 is arranged through these contact rollers 50 and 50. And they are contacted with the front face of the dielectric drum 49 while they are arranged free [ a revolution ], as each contact rollers 50 and 50 avoid the printing area of the front face of the dielectric drum 49. furthermore, the proper pressurization contacted with the support frame which ion write head 16A is supported free [ migration in the direction of the normal of the front face of the dielectric drum 49 ], and was arranged in the tooth back of ion write head 16A, and which is not illustrated -- it enables it to hold a predetermined distance (spacing) to the front face of the dielectric drum 49 with the thrust of a spring 51. In addition, contact pressure of each contact roller 50 may be made small, and the printing area of the dielectric drum 49 may be made to contact.

[0095] Drawing 15 shows the 2nd example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support.

[0096] In this example, like the 1st example shown in drawing 14, the contact roller 50 is not arranged in ion write head 16A, but the desired blade 52 as a cleaning means which makes the dielectric drum 49 at clarification the lower part of ion write head 16A is arranged instead. And the proper waste toner receptacle 53 is arranged at the lower part of a blade 52. Moreover, he is trying to touch the dielectric drum 49 with the record media 55, such as a form, in imprint / fixation section 54 caudad shown in drawing 15.

[0097] By such configuration as well as the 1st example which is shown in drawing 14 and which was mentioned above, the distance of the gate electrode 27A and the latent-image support 28 of ion write head 16A can be held uniformly.

[0098] Drawing 16 shows the 3rd example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support, (a) is a perspective view and (b) is drawing of longitudinal section.

[0099] The dielectric belt 56 of the shape of an endless belt which has flexibility as latent-image support 28 is used for this example.

[0100] The proper belt attachment component 57 is arranged in ion write head 16A, the dielectric belt 56 is positioned to ion write head 16A, and the distance of gate electrode 26A which ion write head 16A does not illustrate, and the front face of the dielectric belt 56 is made to \*\* uniformly in this example. In this case, it is important to set thickness of the dielectric belt 56 constant.

[0101] Since the location of ion write head 16A is easily fixable as compared with the configuration using the dielectric drum 49 shown in drawing 14 and drawing 15 according to such a configuration, it is advantageous when holding uniformly the distance of the gate electrode 27A and the latent-image support 28 of ion write head 16A.

[0102] Drawing 17 shows the 4th example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support.

[0103] This example uses the dielectric belt 56 as latent-image support 28 like the 3rd example shown in drawing 16.

[0104] It pushes against the belt attachment component 57a side which arranged the front face of the dielectric belt 56 so that the front face of ion write head 16A might be covered, and distance is made to hold uniformly in this example. And it forms in belt attachment component 57a of this example by the insulating layer 59 which consists of a proper insulator so that the electrostatic latent image formed in the front face of the dielectric belt 56 in the downstream front face 58 of ion write head 16A may not be disturbed. In addition, while making the downstream front face 58 of ion write head 16A not contact the front face of the dielectric belt 56, the conductive layer 61 which becomes the inlet face 60 of ion write head 16A from a conductive ingredient is formed, and it may be made to discharge the dielectric belt 56.

[0105] Drawing 18 shows the 5th example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support.

[0106] This example makes the structure of the 4th example shown in drawing 17 inject a fluid (air) toward the dielectric belt 56 from the front face of ion write head 16A, and it is made to surface the dielectric belt 56 in fixed height from the front face of ion write head 16A.

[0107] In this example, it prepares in each [ the proper orifice 63 for maintaining the balance of the flow rate of the air which flows each nozzle 62 while forming two or more nozzles 62 is connected / each / front face / of head attachment component 55a / at each nozzle 62 ] passage 64, and supply of application-of-pressure air is enabled to each passage 64. In addition, the flying height to ion write head 16A of the dielectric belt 56 is good to be referred to as about 50 micrometers.

[0108] According to such a configuration, the dielectric belt 56 is not influenced of the conductive existence of the front face of ion write head 16A in order not to contact ion write head 16A. Moreover, since the toner which adheres to the front face of the dielectric belt 56 with the pressure of air and which is not illustrated can be eliminated outside, the inconvenience that a toner adheres to the electron emission section can also be prevented certainly.

[0109] Below, drawing 21 explains the printer which used ion write head 16A of this example from drawing 19.

[0110] Drawing 19 shows the 1st example of the printer concerning this invention.

[0111] The dielectric drum 49 is used for the printer 65 of this example as latent-image support 28.

[0112] As shown in drawing 19, the printer 65 of this example The dielectric drum 49 is arranged free [ a revolution ] by the clockwise rotation shown by the arrow head in drawing 19. Ion write head 16A as latent-image means forming which forms in the perimeter of this dielectric drum 49 clockwise the



electrostatic latent image corresponding to the image of the request which is not illustrated on the dielectric drum 49 from the upper part in drawing 19 , The proper development counter 66 as a development means to develop with the toner which does not illustrate an electrostatic latent image, The application-of-pressure roller 67 as an imprint fixation means by which it is established while imprinting the electrostatic latent image which the toner developed on the record media 55, such as a form, The cleaner 69 which has the proper metal blade 68 as a cleaning means which makes the dielectric drum 49 clarification, and proper AC electric discharge machine 70 as an electric discharge means to remove the electrification condition of the dielectric drum 49 are arranged in order, and are formed.

[0113] The toner (not shown) of the same plus electrification as the normal development using the photo conductor of minus electrification is used for said development counter 66, and it is used especially for the sleeve 71 of a development counter 66 with touch-down potential, without applying bias voltage.

[0114] Moreover, an imprint and fixation make the contact force of a request of the application-of-pressure roller 67 have and contact the dielectric drum 49, and push a record medium 55 against the dielectric drum 49, and the pressure of said contact pressure performs them simultaneously. While fixation becomes possible by this, without using a heat fixing assembly and decreasing power consumption, warm-up time can be made unnecessary.

[0115] Moreover, although the blade (not shown) of the cleaner used for the conventional electrophotography is made into the product made of rubber since a photo conductor (not shown) tends to get damaged, since the blade 68 of the cleaner 69 of the printer 65 of this example has the high reinforcement of the dielectric drum 49, a metal thing can be used for it, and it can raise the precision of a blade 68, and endurance certainly. And for electric discharge of the dielectric drum 49, AC electric discharge machine 70 can neutralize the charge of the front face of the dielectric drum 49 efficiently using the ion of the amphipathy of plus and minus.

[0116] According to the printer 65 of this example which consists of such a configuration, while being able to obtain a high-definition quality of printed character with the conjointly very high repeatability of gradation with the effectiveness of ion write head 16A mentioned above, it can use for various applications.

[0117] Drawing 20 shows the 2nd example of the printer using the head concerning this invention.

[0118] The dielectric belt 56 is used for printer 65a of this example as latent-image support 28.

[0119] as shown in drawing 20 , while being supported free [ a revolution ] in printer 65a of this example -- up and down -- alienation -- two rollers 72 and 73 made into the condition are arranged, either of the rollers 72 and 73 is used as a drive roll, and another side is considered as the follower roll. And as the peripheral face of each roller 72 and 73 is contacted, the dielectric belt 56 is wound. Furthermore, transit of the dielectric belt 56 in the direction shown by the arrow head in drawing 20 with said each rollers 72 and 73 is enabled.

[0120] Ion write head 16A as latent-image means forming which forms in the method of the lower left of said dielectric belt 56 the electrostatic latent image corresponding to the image of the request which is not illustrated is arranged. And the proper development counter 66 as a development means to develop to the method of the lower right of the dielectric belt 56 with the toner which does not illustrate an electrostatic latent image is arranged. Furthermore, the proper cleaner 69 as a cleaning means which carries out clarification of the dielectric belt 56 is arranged at the up left of the dielectric belt 56. Moreover, between ion write head 16A and a cleaner 69, proper AC electric discharge machine 70 as an electric discharge means to remove the electrification condition of the front face of the dielectric belt 56 as it counters with the dielectric belt 56 is arranged.

[0121] The ion generator 74 as electrostatic image transfer which imprints the electrostatic latent image which the horizontal left shown by the arrow head in drawing 20 developed with the toner through the record medium 55 whose transit was enabled on a record medium is arranged in the upper part of said dielectric belt 56. This ion generator 74 is made into the structure of having the same electron emission section 22 as ion write head 16A.

[0122] Moreover, the fixing roller 75 as a fixation means to fix a toner to a record medium 55 according to an operation of heat, and the application-of-pressure roller 76 which has elasticity enable pinching of



a record medium 55, and is arranged at the transit direction downstream of a record medium 55.

[0123] According to printer 65a of this example which consists of such a configuration, the same effectiveness as the printer 65 of the 1st example mentioned above is done so. And the structure of the ion generator 74 used for the electrostatic image transfer of this example does not have the need for image formation, and since there are also few homogeneous demands of a current, the number of the electron emission sections 22 can be reduced, or it can enlarge distance between the ion generator 74 and the dielectric belt 56. Furthermore, since the toner to a record medium 55 is established with a fixing roller 75 and the application-of-pressure roller 76, generating of the gloss of the record medium 55 by crushing the record medium 55 and toner at the time of using the application-of-pressure roller 67 of the printer 65 of the 1st example mentioned above by the high pressure and a toner can be prevented certainly, and a more nearly high-definition quality of printed character can be obtained. Moreover, since the ion generator 74 has the high consistency of the generated ion compared with the generating means of other ion, such as corotron which is not illustrated, an imprint field is limited, and the ion generator 74 can prevent degradation of the image by imprint certainly while miniaturizing like ion write head 16A and being able to operate it with a low battery and a low power. Furthermore, the ion generator 74 is the same polarity as ion write head 16A, and since it can be made to operate with few currents, the power source of the actuation circuit which ion write head 16A does not illustrate can be shared. This can decrease an economic burden certainly while being able to attain certainly the miniaturization of the actuation circuit of the whole printer 65a, equipment (not shown), etc.

[0124] Drawing 21 shows other examples of the printer which used the dielectric belt as latent-image support.

[0125] The ion generator 74 as electrostatic image transfer which imprints the electrostatic latent image which the toner developed like printer 65a of the 2nd example mentioned above in printer 65b of this example on a record medium 55 is not arranged. As an imprint fixation means fixed while imprinting a toner to a record medium 55 instead, as a fixing roller 75 and the application-of-pressure roller 76 pinch dielectric belt 56a formed with heat-resistant raw materials, such as polyimide, they are arranged. This fixing roller 75 caudad Two rollers 72 and 73 are arranged at parallel at right and left, and as said dielectric belt 56a contacts each peripheral face of said fixing roller 75 and two rollers 72 and 73, it is wound around it.

[0126] Ion write head 16A as latent-image means forming which forms in the lower part of said dielectric belt 56a the electrostatic latent image corresponding to the image of the request which is not illustrated is arranged, and the proper development counter 66 as a development means to develop to the method of the lower right of dielectric belt 56a with the toner which does not illustrate said electrostatic latent image is arranged. Furthermore, the proper cleaner 69 as a cleaning means which makes dielectric belt 56a clarification is arranged at the method of the lower left of dielectric belt 56a, and proper AC electric discharge machine 70 as an electric discharge means to remove the electrification condition of dielectric belt 56a as the upper part is countered with dielectric belt 56a is arranged.

[0127] While doing so the same effectiveness as printer 65a of the 2nd example mentioned above according to printer 65b of this example which consists of such a configuration, \*\*\*\* of the image at the time of an imprint can be prevented more certainly, and a more nearly high-definition quality of printed character can be obtained, and a miniaturization can be attained easily. In addition, the heater element of a single dimension like a thermal head or a 2-dimensional heating element can also be used instead of a fixing roller 75.

[0128] Moreover, this invention is not limited to said each example, and the combination of said each ion write heads 16, 16a, and 16b, said individual electrodes 21 and 21a, and each of said actuation circuits 31, 31a, and 31b can be chosen from the thing of various kinds of combination that what is necessary is for a design concept just to determine.

[0129] This invention is not limited to said each example, and can be changed further again if needed.

[0130]

[Effect of the Invention] Thus, according to the ion write head of this invention, since ion is generated by the principle of thermionic emission, ion can be generated in low energy. Moreover, in order not to

use corona discharge for generating of ion, there is no generating of ozone. Moreover, since the magnitude of the ionic current which contributes to writing is controllable only by controlling the electric field applied between a gate electrode, an individual electrode and an individual electrode, and latent-image support, the magnitude of the toner image formed is changed to many stairways, and the extremely excellent effectiveness, like a multi-tone print can be performed easily is done so.

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[Translation done.]

\* NOTICES \*

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TECHNICAL FIELD

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[Industrial Application] This invention relates to the suitable ion write head for the electrostatic recording equipment which the charged particle corresponding to an image is made to adhere selectively from the exterior, and forms an electrostatic latent image on the latent-image support constituted with a dielectric.

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PRIOR ART

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[Description of the Prior Art] While the mechanical reinforcement of latent-image support is high in recent years as compared with the photo conductor used as latent-image support in the conventional electrophotography method and using the latent-image support formed with the dielectric which is excellent also in the stability over temperature or a repeat At high speed, the printer of the ion write-in formula which forms an electrostatic latent image using a charged particle (ion) instead of the conventional light has dramatically much printing number of sheets, and is used abundantly at few [ the frequency of a maintenance ] business-use high-speed printers etc. And since control of latent-image potential is easy as compared with the printer of the electrophotography method which used the photo conductor, by controlling the coating weight of developers, such as a toner, the printer of an ion write-in formula is suitable for printing which has concentration gradation, and suitable for the full color printer than to which greater importance is attached to the repeatability of concentration gradation.

[0003] Hereafter, such the conventional ion write head is explained.

[0004] Drawing 22 shows an example of the conventional ion write head, (a) is the perspective view showing the whole configuration, and (c) is [ (b) is drawing of longitudinal section showing the configuration of an important section, and ] the explanatory view showing the arrangement condition of a line electrode and a finger electrode.

[0005] As shown in (a) of drawing 22 , the screen electrode 2 is formed on the surface of one side, two or more openings 3 are arranged and formed in the front face serrate, and the conventional ion write head 1a is made abbreviation plate-like as a whole. And as shown in (b) of drawing 22 , the screen electrode 2, the finger electrode 4 with opening 3, and the line electrode 5 are arranged through the insulating layer 6 which consists of a desired dielectric, respectively. Moreover, as shown in (c) of drawing 22 , the opening 3 of the finger electrode 4 and the line electrode 5 are arranged in the shape of a matrix. And as shown in (b) of drawing 22 , each opening 3 is arranged in it as ion write head 1a counters the latent-image support 7.

[0006] In such conventional ion write head 1a, by the actuation circuit of the request which is not illustrated between the finger electrode 4 and the line electrode 5, the frequency of 1MHz and about [ electrical-potential-difference 1kV ] high-frequency voltage are impressed, and the ion 8 ((b) of drawing 22 ) as a charged particle by discharge is generated in the atmospheric air of the circumference of the finger electrode 4. Moreover, as shown in (c) of drawing 22 , two or more line electrodes 5 are formed, and high-frequency voltage is impressed to one of them one by one. And the direct current voltage of -600V is impressed to the screen electrode 2, and the electrical potential difference of -400V is impressed to the finger electrode 4 at the time of -700V and printing at the time of standby.

Furthermore, pulse width at the time of printing is made about [ 20micro ] into S, and for example, it generated in the atmospheric air of the circumference of the finger electrode 4, the polar ion 8 of minus is controlled by the screen electrode 2, and it is made to collide with the latent-image support 7 through opening 3, as shown in (b) of drawing 22 .

[0007] Said latent-image support 7 is used as the so-called dielectric drum 11 on which the desired dielectric layer 10 was formed in the front face of the metal drum 9 as shown in (b) of drawing 22 , and

said metal drum 9 is grounded. And as mentioned above, the electrostatic latent image corresponding to the image of the request which is not illustrated is formed in the front face of the dielectric drum 11 by making the polar ion 8 of minus as a charged particle collide with the front face of the dielectric drum 11.

[0008] The conventional ion write head 1b of other examples is shown, in this conventional ion write head 1b, corotron 12 is used for generating of the ion 8 as a charged particle, the control electrodes 14 and 14 of two sheets which have two or more desired openings 13 in that front face are arranged, and drawing 23 is driven by the proper actuation circuit 15. And it is controlled whether the ion 8 8 generated in corotron 12, for example, the ion of a plus polarity, makes it reach from opening 13 to the latent-image support 7 with the polarity of the electrical potential difference applied among the control electrodes 14 and 14 of two sheets. Moreover, distance between the control electrodes 14 and 14 of two sheets is set to about 100 micrometers, and the diameter of opening 13 is set to about 200 micrometers. Furthermore, resolution of ion write head 1b is carried out in about 8 dots/mm. Moreover, said opening 13 is arranged by serrate like the opening 3 of head 1a shown in (a) of drawing 22 mentioned above.

[0009]

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EFFECT OF THE INVENTION

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[Effect of the Invention] Thus, according to the ion write head of this invention, since ion is generated by the principle of thermionic emission, ion can be generated in low energy. Moreover, in order not to use corona discharge for generating of ion, there is no generating of ozone. Moreover, since the magnitude of the ionic current which contributes to writing is controllable only by controlling the electric field applied between a gate electrode, an individual electrode and an individual electrode, and latent-image support, the magnitude of the toner image formed is changed to many stairways, and the extremely excellent effectiveness, like a multi-tone print can be performed easily is done so.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, in the conventional ion write head 1 (a sign names generically the conventional ion write heads 1a and 1b) mentioned above, since it is impossible to make latent-image formation generate the ion 8 of only a complement on real time, a lot of ion 8 is always generated, the part is drawn on the latent-image support 7 by the screen electrode 2 or the control electrode 14 of two sheets, and 14 grades, and an electrostatic latent image is formed. For this reason, the utilization effectiveness of the generated ion 8 was low, and there were various troubles of processing of the ozone generated simultaneously with ion 8, buildup of power consumption, enlargement of a head 1, enlargement, formation of an expensive rank of the actuation circuit 15 for control electrodes that controls high tension, etc.

[0010] Moreover, in the conventional ion write head 1, there was a trouble that the minimum of the magnitude of the openings 3 and 13 which ion 8 passes had constraint. One of the constraint of this is for enlarging utilization effectiveness of the generated ion 8, I hear that another must make the process tolerance and isolation voltage of the screen electrode 2 which impresses high tension, or a control electrode 14 hold, and there is.

[0011] That is, the trouble of using the screen electrode 2 or control electrode 14 which has the big openings 3 and 13 is a point that the diameter of 1 dot of the electrostatic latent image formed when the point that the absolute value of control voltage becomes large, and the ion 8 (ionic current) which flows toward the latent-image support 7 from the ion write head 1 are extracted does not become small enough. In extracting an ionic current, the diameter of an ionic current converges on about [ of the diameter of the openings 3 and 13 of control electrodes 2 and 14 / 1/several ] for the electrical potential difference which joins electrodes 2 and 14. For this reason, the diameter of 1 dot of the electrostatic latent image formed becomes small compared with an increase or the case where it carries out, about an ionic current. However, the potential of the electrostatic latent image at the time of extracting an ionic current for the limitation of the rate of focusing serves as an in-between value, and will reproduce halftone with potential.

[0012] Moreover, although the repeatability in the case of area gradation is good when reproducing concentration gradation with the coating weight of a toner, the repeatability in the case of concentration gradation does not have so good repeatability by factors, such as dispersion in the amount of electrifications of a toner. Generally, it is said that the conventional ion write head 1 is excellent in the repeatability of concentration gradation compared with other write-in methods. Although the repeatability and stability of gradation in case many flow rates of ion 8 go into the field of area gradation are excellent if it sees strictly about this repeatability, the tone reproduction at the time of extracting the flow rate of ion 8 is inferior compared with the high concentration field. And when not changing but reproducing gradation by change of potential, there cannot but be many factors which degrade the grace of images, such as dispersion in the coating weight of a toner, at a development process, and the area of an electrostatic latent image cannot but become what was inferior to the tone reproduction in area gradation as a result, even if formation of an electrostatic latent image is performed to accuracy to an input signal.

[0013] That magnitude of said openings 3 and 13 cannot be made small has the trouble of the constraint on the design of not comparing openings 3 and 13 with the ability of resolution not being raised on a straight line.

[0014] Generally, although the quality of printed character of fixed level can be obtained to the repeatability of the binary picture of white and black also in the printer of an electrophotography method, the repeatability of an image including halftone is not good. Then, in a current electrophotography method, the approach of reproducing halftone in false is in use with the area gradation using a dither, and the resolution of printing at the time of using a dither falls substantially compared with the resolution in electrostatic latent-image means forming.

[0015] The matrix of a typical dither is formed by 4x4 pixels or about 6x6 pixels. The tone reproduction in that case becomes 16 steps and 36 steps, and the resolution of the image formed is set to 1/4 or 1/6. When thinking a tone reproduction as important, in order to obtain practical resolution, it is necessary to form an electrostatic latent image with dramatically high resolution.

[0016] In the printer using the conventional ion write head 1, since the repeatability of halftone is excellent, the rendering of concentration gradation is possible also for not depending on a dither, either. Therefore, it has been thought that the trouble that resolution cannot be raised because of a limit of the magnitude of openings 3 and 13 etc. is suppliable with the repeatability of concentration gradation. That is, in the application over which priority is given to a tone reproduction like a photograph, even if resolution was low, when the tone reproduction was excellent, repeatability was suppliable, but in the application as which high resolution, such as printing of an alphabetic character, is required, though some improvements could be made using the tone reproduction, there was a trouble that only the quality of printed character which was substantially inferior to the electrophotography method with high resolution was obtained.

[0017] Moreover, it sets to the conventional ion write head 1. Two or more openings 3 and 13 cannot be formed in the print width direction in a straight line. Two or more openings 3 and 13 were arranged aslant, and when the method which forms the electrostatic latent image of one line in time sharing was used, the nonuniformity of a rate was in the latent-image support 7 or the timing of writing shifted to it, there was a trouble that the location of an electrostatic latent image shifted and a quality of printed character deteriorated substantially. Moreover, a control circuit, the actuation circuit 15, etc. which are not illustrated tended to become complicated and expensive by rearrangement of an image, generating of timing, etc., ion write head 1 the very thing was enlarged, and there was a trouble that it became difficult to keep constant the distance between the ion write head 1 and the latent-image support 7.

[0018] This invention is made in view of these points, and the trouble in the conventional thing mentioned above is conquered, and it is small and aims at offering the ion write head with the high utilization effectiveness of ion.

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MEANS

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[Means for Solving the Problem] In order to attain the object mentioned above the ion write head of this invention according to claim 1 Two or more individual electrodes which are the ion write head which a charged particle is made to adhere selectively and forms an electrostatic latent image on the latent-image support constituted with a dielectric, and were formed on the substrate, The electron emission section which may emit the electron for generating a charged particle by being formed on said individual electrode and heated, It is characterized by having a heating unit for heating said electron emission section, and a gate electrode for accelerating the electron which collaborated with said individual electrode and was emitted from said electron emission section.

[0020] And the ion write head of this invention according to claim 2 is characterized by said individual electrode making said heating unit serve a double purpose in claim 1.

[0021] Furthermore, the ion write head of this invention according to claim 3 is characterized by forming said electron emission section considering a ferroelectric as a subject in claim 1 or claim 2.

[0022] Moreover, the ion write head of this invention according to claim 4 is characterized by having the actuation circuit which makes said heating unit generate heat to predetermined timing in any 1 term of claim 1 thru/or claim 3.

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OPERATION

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[Function] The ion write head of this invention which consists of a configuration mentioned above By generating ion using the so-called principle of thermionic emission, and heating the heating unit formed on the substrate Heat the electron emission section, make a thermoelectron emit from here, accelerate by the electric field to which this electron is impressed between the gate electrode and the individual electrode, and ion is generated. It can be made to be able to move to the front face of latent-image support by the electric field to which this ion is impressed between an individual electrode and latent-image support, and an electrostatic latent image can be formed in the front face of latent-image support.

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EXAMPLE

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[Example] Hereafter, the example which shows this invention to a drawing explains.

[0025] Drawing 3 shows the 1st example of the ion write head concerning this invention from drawing 1, drawing 1 is drawing of longitudinal section showing the configuration of an important section, it is a cutting top view a part and drawing 2 is a circuit diagram showing the configuration of an important section in which drawing 3 shows an actuation circuit.

[0026] As shown in drawing 1 and drawing 2, the heat insulating layer 18 is arranged on the substrate 17, and, as for the ion write head 16 of this example, the heater layer 19 is arranged in the top face of this heat insulating layer 18. And it is called two or more cathode electrodes which corresponded to resolution (pixel number) through the medium insulating layer 20 on the top face of the heater layer 19, for example, alignment arrangement of the individual electrode 21 which has the base 77 with a diameter of about 30 micrometers is carried out in drawing at the longitudinal direction (the print width direction) at the shape of a single tier. Furthermore, the electron emission section 22 which may emit the electron for generating a charged particle (ion) is arranged in the top face of the base 77 of the electrode 21 according to each. Moreover, the conductive layer 23 for centralizing generation of heat of the heater layer 19 to each electron emission section 22 is arranged in the top face of the heater layer 19 except for the part which counters each electron emission section 22. That is, let the part which is not covered with the conductive layer 23 corresponding to each electron emission section 22 of the heater layer 19 be the heating unit 24 for heating each electron emission section 22 in this example. On a substrate 17, it centered on each electron emission section 22, for example, the gate electrode 26 which has the circular opening 25 with a diameter of about 20 micrometers is arranged through the insulating layer 27 of proper thickness further again, and it is formed in abbreviation plate-like as a whole.

[0027] that in which thermal resistance is high and has required mechanical strength and workability as a raw material of said substrate 17 -- it is -- it is -- \*\*\*\*ing -- insulating materials and front faces, such as an alumina ceramic and glass, -- SiO<sub>2</sub> etc. -- various things, such as a silicon substrate which carried out the clad with the insulating material, can be chosen.

[0028] As a raw material of said heat insulating layer 18, various things, such as high-melting glass with the small heat conductivity, foam glass, a zirconia ceramic, and a silicon dioxide, can be chosen.

[0029] As a raw material of said heater layer 19, various things, such as a tungsten, Nichrome, and tantalum nitride, can be chosen.

[0030] since big electric field are put to the ion added and generated as a raw material of said medium insulating layer 20 -- SiO<sub>2</sub> with high insulation performance and stability, and Al<sub>2</sub>O<sub>3</sub> etc. -- it is desirable to use the insulating material of an inorganic substance.

[0031] It is desirable to use metal raw materials, such as platinum, a tungsten, a tantalum, and molybdenum, in consideration of conductivity and workability as a raw material of said individual electrode 21.

[0032] the ferroelectric which has the thermionic-emission operation which emits an electron with heating as a raw material of said electron emission section 22, for example, barium titanate, strontium titanate, zirconic acid barium, zirconic acid strontium, etc. can be illustrated, and independent [ if

needed ] in these -- or it can combine and use.

[0033] As a raw material of said conductive layer 23, it has small electric conductivity and platinum high to thermal resistance, a tantalum, a tungsten, molybdenum, etc. are more desirable than the heater layer 19.

[0034] Various things, such as molybdenum and a tantalum, can be chosen as a raw material of said gate electrode 26.

[0035] since heat is added while big electric field are put to the ion added and generated as a raw material of said insulating layer 27 -- transparence with high insulation performance and stability with little heat loss or white SiO<sub>2</sub>, and Al<sub>2</sub>O<sub>3</sub> etc. -- it is desirable to use the insulating material of an inorganic substance.

[0036] Moreover, as a fictitious outline shows to drawing 1, the latent-image support 28 in which an electrostatic latent image is formed as the gate electrode 26 of said ion write head 16 is countered is arranged. While the proper dielectric layer 30 is formed in the front face of the desired metal base 29, this latent-image support 28 The fixed distance G of about 100 micrometers (gap) is separated from said gate electrode 26, it is arranged, and migration is made free with constant speed in the direction of vertical scanning which intersects perpendicularly to the main scanning direction where said each electron emission section 22 is arranged.

[0037] As shown in drawing 3, the reference potential is formed when the actuation circuit 31 of the ion write head 16 of this example grounds the metal base 29 prepared in the opposite hand to the ion write head 16 of the latent-image support 28 as a back plate 32. While connecting electrically, let the power source VL for latent-image writing to which this actuation circuit 31 supplies the polar electrical potential difference of minus to the gate electrode 26 be a common electrode [ as opposed to the electrode 21 according to each in the gate electrode 26 ]. And each actuation transistor 33 makes the gate electrode 26 a reference potential, and the electrode 21 according to each is connected to the power source VE for electronic acceleration which impresses the polar electrical potential difference of minus to the gate electrode 26 through the current setting-out resistance 34 while connecting with the respectively proper actuation transistor 33. Moreover, the power source VH for heating is electrically connected to the heater layer 19 through the temperature control section which is not illustrated for always controlling the exoergic temperature of a heating unit 24 to fixed temperature. In addition, as for the energization of the power source VH for heating to the heater layer 19, it is desirable to control by the pulse voltage which synchronized with formation of the electrostatic latent image of each pixel based on a control command.

[0038] If said actuation circuit 31 is explained further, the actuation circuit 31 of this example will be constituted by the current regulator circuit, and the current of this current regulator circuit will be determined as the current setting-out resistance 34 connected to the emitter of each actuation transistor 33 with the electrical potential difference applied to the base of each actuation transistor 33. And the base electrical potential difference of each actuation transistor 33 is impressed by inputting the digital signal by which weighting was carried out through the D/A conversion circuit 35 which combined resistance with the ladder mold. Furthermore, the input signal over the ion write head 16 is made into the serial signal 36 in which each has another weight, and is changed into a parallel signal by the shift register 37 corresponding to each serial signal 36. Moreover, once this parallel signal is held at latch 38, it is outputted to a gate circuit 40 by the latch signal 39, takes ANDO with a strobe signal 41 by the gate circuit 40, and is inputted into the D/A conversion circuit 35. This strobe signal 41 is a signal which determines the operating time over the gate electrode 26 of the individual electrode 21.

[0039] That is, the electrode 21 according to each in this example is electrically connected to the actuation circuit which is insulated separately and has a constant current characteristic, and the heater layer 19 has connected each heating unit 24 to a serial.

[0040] In addition, power is reducible by considering as the configuration which divides the heater layer 19 and is made into two or more groups.

[0041] Below, (j) explains the production process of the ion write head 1 of this example from (a) of drawing 4.



[0042] First, sequential membrane formation of the heat insulating layer 18 which becomes the top face of the abbreviation plate-like proper substrate 17 which consists of insulating materials, such as glass, from a silicon dioxide, the heater layer 19 which consists of tantalum nitride, and the conductive layer 23 which consists of a tantalum is carried out using the well-known thin film formation approach. And etching etc. removes the position of the heater layer 19 and a conductive layer 23 in the same configuration, and as shown in (a) of drawing 4, and (b), the heater layer 19 and a conductive layer 23 are formed in a predetermined configuration. Subsequently, as etching etc. removes the position of a conductive layer 23 and it is shown in (c) of drawing 4, and (d), the predetermined part of the heater layer 19 is exposed and a predetermined number corresponding to the number of pixels of heating units 24 are formed. the next -- SiO<sub>2</sub> from -- after forming the becoming medium insulating layer 20 similarly using the well-known thin film formation approach, as shown in (e) of drawing 4, and (f), only the predetermined number corresponding to the number of pixels forms the individual electrode 21 which consists of metals, such as a tantalum, using the well-known thin film formation approach and well-known etching. the next -- SiO<sub>2</sub> from -- as the becoming insulating layer 27 and the gate electrode 26 which consists of metals, such as a tantalum, are similarly shown in (g) of drawing 4, and (h) after \*\*\*\*\* one by one, etching etc. removes the position of the gate electrode 26 and the opening 25 of desired magnitude is formed. Subsequently, etching etc. removes the position of an insulating layer 27, and as shown in (i) of drawing 4, the individual electrode 21 located under the opening 25 is exposed. By carrying out migration electrodeposition of the electrodeposited liquid which contains a ferroelectric on the individual electrode 21 next, and forming an electrodeposited film, the electron emission section 22 is formed and manufacture of the ion write head is completed. In addition, when forming the electron emission section 22, after forming the proper mold release layer (not shown) by the photoresist etc. on the gate electrode 26 at the process and forming the electron emission section 26 before forming the electron emission section 22, it is good to remove a mold release layer.

[0043] Below, it explains in more detail about formation of the electron emission section 22 of the ion write head 16 of this example.

[0044] In order to form the electron emission section 22 of this example, the electrodeposited liquid which uses a ferroelectric as a principal component is formed first. This electrodeposited liquid grinds the ferroelectric powder of perovskite molds, such as barium titanate, to particle-size extent of 1 micrometer or less with wet grinding, washes it with pure water, and removes impurities, such as a barium hydroxide. Next, 1% (wt%) of pure water as an electrolyte and 0.0012% (wt%) of calcium chlorides are added to a methanol, and the electrolytic solution is formed. Next, electrodeposited liquid is formed by adding the powder of a ferroelectric compound to said electrolytic solution 0.15%. PH of this electrodeposited liquid is a little less than seven, and conductivity is 30microS/cm extent. Although the ferroelectric compound itself is chemically stable and the solubility to water is small at this time, oxides, such as unreacted barium and titanium, react with water, turn into a hydroxide, and dissolve in water, and in order to reduce the resistivity of electrodeposited liquid, it is necessary to remove them beforehand. Moreover, in electrodeposited liquid, the calcium chloride in the electrolytic solution is ionized in calcium ion and a chloride ion, and is incorporated as a calcium hydroxide in the electrodeposited film formed. Subsequently, after stirring electrodeposited liquid, by putting for several hours, a ferroelectric compound with a large particle size is made to sediment, it removes, and manufacture of electrodeposited liquid is completed.

[0045] An electrodeposited film is formed on [ classified by each ] an electrode 21 by using the individual electrode 21 of the ion write head 16 as cathode, applying an about [ 50V ] electrical potential difference using the platinum which is hard to ionize to an anode plate, and next, performing migration electrodeposition. The current density at the time of this migration electrodeposition is 2 70mA/cm. Extent and an electrodeposition rate are good to consider as 1 micrometer/min extent.

[0046] The electron emission section 22 is formed on [ classified by each ] an electrode 21 by performing heat treatment heated at about 200-300 degrees C in atmospheric air for several hours next, removing a methanol, and heating in atmospheric air or a vacuum at the temperature of about 600 degrees C after that for several hours. In addition, the calcium hydroxide incorporated in the

electrodeposited film reacts with the carbon dioxide in atmospheric air by heat treatment, a part serves as a calcium carbonate, the remainder serves as a calcium oxide, and these lime compounds carry out the duty of cement which hardens between the fine particles of a ferroelectric (ferroelectric compound), and make firm the electrodeposited film used as the electron emission section 22 formed on [ classified by each ] the electrode 21.

[0047] Next, the ion write head 16 of this example was put into the vacuum tub, the electron emission section 22 was heated, and the amount of electron emission (emission) was evaluated. Whenever [ stoving temperature ] was gradually made high and the process which emission increases from a minute current field was recorded. The emission to each temperature is the same level as the thermionic-emission raw material of the oxide covering form of common barium or calcium, and has checked that a work function was almost equal. Moreover, when it was made to operate at the temperature for several hours, it has checked that the property was stable.

[0048] Subsequently, when the pressure of a vacuum tub was gradually made high toward the atmospheric pressure condition from the vacua and the property in the inside of atmospheric pressure was evaluated eventually, it became clear by enlarging the electric field between the individual electrode 21 and the gate electrode 26 that an electron could be efficiently emitted from the electron emission section 22. And the current which can be taken out from the electron emission section 22 was proportional to the electric field between the individual electrode 21 and the gate electrode 26, and while having a relation in inverse proportion to a distance in the meantime, it became clear that the current which can be taken out in atmospheric air was 1/100 to about 1/1000 as compared with the case in a vacuum.

[0049] Below, an operation of the ion write head 16 mentioned above is explained.

[0050] If the ion write head 16 of this example is made to drive and the current of the power source VH for heating is energized in the heater layer 19, the heating unit 24 formed in the heater layer 19 will generate heat, and generation of heat of this heating unit 24 will heat the individual electrode 21 and the electron emission section 22 to predetermined temperature. And the heated electron emission section 22 emits an electron (thermoelectron) to the space of the outside of the electron emission section 22 by the principle of thermionic emission.

[0051] The electron emitted to the space of the outside of said electron emission section 22 is caught by the oxygen molecule in the space between the gate electrode 26 and the latent-image support 28, after being accelerated by the electric field formed of the electrical potential difference of the power source VE for electronic acceleration impressed between the individual electrode 21 and the gate electrode 26, and it becomes oxygen ion, and the polar ion (not shown) of minus as a charged particle is generated. This ion moves toward the front face of the latent-image support 28 by the electric field which are impressed between the gate electrode 26 and the back plate 32 of the latent-image support 28, and are formed of the electrical potential difference of the power source VL for slack latent-image writing.

[0052] Moreover, the ion write head 16 of this example The electrode 21 according to each is formed in the shape of a single tier using a certain thin film formation approach, etching, etc. from the former. While being formed by making the upper part electrodeposit the electron emission section 22 and being able to form easily the electrode 21 according to each and the electron emission section 22 of complicated and detailed structure It can form in the shape of a line, and the resolution of the ion write head 16 can be raised easily.

[0053] Below, generation of ion and migration of ion are explained.

[0054] In this example, the gap G between the gate electrode 26 and the latent-image support 28 is set to 100 micrometers, potential of the gate electrode 26 is set to -500--600V to the back plate 32 of the latent-image support 28, and the electric field between the gate electrode 26 and the latent-image support 28 are carried out [ mm ] in 5-6kV /. The value of this electric field is a value of one half extent of the sparkover voltage in the atmospheric air in the gap G between the gate electrode 26 and the latent-image support 28.

[0055] Moreover, when an electron is made to emit into atmospheric air by heating the electron emission section 22 The mean free path of the oxygen molecule in about 400nm and atmospheric air of



the mean free path of the electron in the inside of the air of atmospheric pressure is 64nm. The emitted electron is  $10^3$ - $10^4$ , while carrying out the drift of the between with a gap [ G ] of 100 micrometers. It collides with the gas molecule in time atmospheric air, it is caught by an oxygen molecule and the molecule of a steam probable, and the polar ion (O<sup>2-</sup>-ion) of minus as a charged particle is generated. At this time, about by  $2 \times 10$  to four, where ion and an electron are mixed, the probability for the electron of low energy to be caught by the oxygen molecule serves as an ionic current, arrives at the front face of the latent-image support 28, and it gives the polar charge of minus to the front face of the latent-image support 28, and the polar detailed electrostatic latent image of minus is formed in the front face of the latent-image support 28. That is, surface potential of the latent-image support 28 of an initial state (before an electrostatic latent image is written in) is set to 0V by electric discharge, and the electrostatic latent image of the potential which is proportional to the amount of attainment of the polar ion of minus of an electron on reception and its front face from the polar ion of the minus which arrived at the front face of the latent-image support 28 is formed. Since the ion and electron which arrive at the front face of the latent-image support 28 at this time move to line of electric force at parallel, that breadth can be disregarded until electrostatic latent-image potential is saturated. The maximum of the potential of this electrostatic latent image is saturated with the value near the electrical potential difference of the power source VL for latent-image writing.

[0056] Therefore, the polar ion of the minus which arrived at the front face of the latent-image support 28 after the potential of an electrostatic latent image was saturated moves to the one where latent-image potential is smaller along the front face of the latent-image support 28, and gives a charge to the front face of the part. That is, the electrostatic latent image on the latent-image support 28 will spread in concentric circular. The breadth of this electrostatic latent image decreases, so that the gap G between the gate electrode 26 and the latent-image support 28 is short.

[0057] The mass of said ion is  $5.9 \times 10^4$  of an electron. It is about twice, and passing speed of the ion by the electric field between said gate electrodes 26 and back plates 32 of the latent-image support 28 is made into 100 m/S extent, and the transit time of the ion between said gaps G of 100 micrometers becomes about [ 1micro ] S.

[0058] Here, the time amount which the magnitude of one pixel (dot) will be about 84.67-micrometer angle, and the writing of one line will take the resolution of image formation if passing speed (process rate) of 300DPI and the latent-image support 28 is made into 100 mm/S is set to 847microS, and since the passing speed of ion is fully shorter than the write time of one line, it does not become the failure of the writing of an electrostatic latent image.

[0059] Moreover, when there is little emission from the electron emission section 22, the ionic current which the electrical potential difference of the gate electrode 26 is subtracted to the potential of the electron emission section 22, and the potential of the part near the opening 25 of the space around the electron emission section 22 is subtracted, and becomes from ion and an electron is converged on the core of the opening 25 of the gate electrode 26. The convergence rate of the ionic current to the opening 25 of this gate electrode 26 becomes about 3 times at the maximum.

[0060] that is, the amount of the ion which concentrates the magnitude of the electrostatic latent image formed on the latent-image support 28 on the small diameter which line of electric force reaches when there are few amounts of the polar ion of the minus which arrives at the front face of the latent-image support 28, and reaches -- increasing -- \*\* -- the polar potential of minus of the electrostatic latent image which is not rises, and the line of electric force which arrives at the front face of the latent-image support 28 spreads. The area of a breadth electrostatic latent image will be expanded to concentric circular by the polar ion of the minus which takes and reaches it on the front face of the latent-image support 28.

[0061] Therefore, linearity of the area of the electrostatic latent image over the amount of the generated ion can be made very high.

[0062] [ when developing an electrostatic latent image with a toner and considering as a toner image ] namely, the linearity of the coating weight of a toner By the case where the area of the electrostatic latent image of the case where the potential of an electrostatic latent image has halftone, and fixed potential changes Since area gradation can form the electrostatic latent image of a detailed area also in a



low printing concentration field and printing by wide range area gradation is attained, the ion write head 16 of this example The high-definition quality of printed character in which the repeatability of gradation was extremely excellent compared with the conventional ion write heads 1 and 1a can be obtained. This quality of printed character is excellent also to the quality of printed character of an electrophotography method which has the high resolution used for the application as which high resolution, such as printing of an alphabetic character, is required.

[0063] Amplification of the area of said electrostatic latent image does not necessarily break out indefinitely, and is restricted to the fixed range according to the amount of the ion which reaches by the electric field impressed between the gate electrode 26 and the back plate 32 of the latent-image support 28. Moreover, the potential of the electrostatic latent image formed is also restricted to the almost fixed value near the electrical potential difference impressed between the gate electrode 26 and the back plate 32 of the latent-image support 28.

[0064] Although the gap G between said gate electrodes 26 and latent-image support 28 is restricted by the precision of the gap G between the gate electrode 26 at the time of making it run the danger and the latent-image support 28 of the short circuit by trespass of a toner, and the latent-image support 28, as for the gap G between the gate electrode 26 and the latent-image support 28, it is desirable to constitute so that the distance G of abbreviation regularity may always be held.

[0065] In addition, since it collides with the front face of the gate electrode 26 with which the polar ion of the plus which exists in atmospheric air is formed in the front face of the ion write head 16 of the electric field between the gate electrode 26 and the latent-image support 28, and potential is [ area ] large subtracted most, the probability which carries out the spatter of the electron emission section 22, and is exhausted is very small, and the electron emission section 22 can hold the function continued and stabilized at the long period of time.

[0066] Moreover, since the rate which ion moves is proportional to the magnitude of electric field, it is desirable to consider as high electric field within limits which do not carry out dielectric breakdown.

[0067] Below, a current required for electrostatic latent-image formation is explained.

[0068] The potential of the electrostatic latent image formed in the front face of said latent-image support 28 is decided by the ratio of the electrostatic capacity of the dielectric layer 30 of the ion or electronic charge which reaches the latent-image support 28, and the latent-image support 28. Here, when thickness of the dielectric layer 30 of the latent-image support 28 is set to 20 micrometers and the dielectric constant is set to 2.5, it is 2.1 cm. The electrostatic capacity of a hit is set to 110.7pF. The charges taken to electrify the dielectric layer 30 of this latent-image support 28 from OV to -500V are 55.35nC(s). When width of face of the image recording of the latent-image support 28 is made to 210mm and a process rate is made into 100 mm/s, a current required of the ion write head 16 whole is 11.62microA. The number of pixels at the time of setting the die length of the printing section to 210mm becomes 2480 pieces in 300DPI, becomes 3307 pieces in 400DPI, and the average current per electrode 21 according to each serves as 4.69nA(s) in 300DPI, and it serves as 3.51nA(s) in 400DPI.

[0069] When magnitude of said individual electrode 21 is made into the diameter of 30 micrometers, the area is  $7.07 \times 10^{-6}$  cm<sup>2</sup>. Current density is 497microA/cm<sup>2</sup> in 663microA/cm<sup>2</sup> and 400DPI at 300DPI. It becomes. And 100 mA/cm<sup>2</sup> in the case of operating the individual electrode 21 in a vacuum in respect of current density Although it is quite small, it is equivalent level when it takes that ion or electrons are scattered about in atmospheric air, and mobility falls into consideration. The magnitude of this individual electrode 21 is restricted by current density and the dimensional accuracy by the processing technique.

[0070] Below, the tone reproduction at the time of using a liquid phenomenon is explained.

[0071] As for the tone reproduction at the time of using a liquid phenomenon, the resolution of the ion write head 16 serves as a determinant. The diameter of 30 micrometers and the gate electrode 26 is set to 20 micrometers for the diameter of the individual electrode 21, the minimum of the magnitude of an electrostatic latent image is set to 7 micrometers, the upper limit of the magnitude of an electrostatic latent image serves as 84.67-micrometer angle in 300DPI, and the ion write head 16 in this example serves as 63.5-micrometer angle in 400DPI. And dot area in case the diameter of an electrostatic latent

image is 7 micrometers is 2 38.5 micrometers. Becoming, an area of 1 pixel of each resolution is 2 4032 micrometers in 2 and 400DPI 7069 micrometers at 300DPI. It becomes, and it can become 183.6 times in 300DPI, it can become 104.7 times in 400DPI, and surface ratio can be made without a dither into outline 128 gradation (7 bits) extent. Furthermore, each color 256 gradation (8 bits) 1,670,000 color specification is possible by the dither of a 2-4-pixel unit.

[0072] Below, the tone reproduction of a using-dry developing case is explained.

[0073] As for the tone reproduction at the time of using dry developing, the particle size of a toner serves as a determinant. Whenever [ by the current grinding method / high image ], a typical particle size of a toner is about 7 micrometers, and the minimum of the magnitude of an electrostatic latent image is set to about 14 micrometers. The dot area in this case is 2 153.9 micrometers. The surface ratio of an electrostatic latent image becomes 45.9 times in 300DPI, and becomes 26.2 times in 400DPI, and processing of a dither becomes unnecessary when the printing concentration of each pixel is larger than the minimum value determined by the above-mentioned surface ratio, since the linearity of the magnitude of an electrostatic latent image is high. Moreover, when printing concentration is smaller than the minimum value of the above-mentioned surface ratio, in order to obtain a gradation rendering with a color [ each ] of 8 bits, it is good to use the dither of 9 dots of 3x3, and the matrix of the 16-dot unit of 4x4.

[0074] Below, the resolution in ion writing is explained.

[0075] According to the printer using the ion write head 16 of this example, it can reappear without 8-bit (256 gradation's) a total of 1,670,000 colors' almost using a dither for three primary colors respectively, and resolution of an image can be made into the level near a photograph or a sublimation mold.

[0076] In the case of the image of the bit map of a color, there will be few pixels of a great portion of data because of a limit of amount of information than the number of pixels of the image constituted by the ion write head 16, and it will expand with software, and will print. As the typical number of pixels, 640 dots wide, the length of 480 dots, and the amount of information of 24 bits (1,670,000 colors) become 900 K bytes, when not compressing data. The resolution in the case of printing the image in 8cm wide and 6cm long magnitude is set to mm in 8 dots (about 200 DPI) /. It is possible to acquire the 300 - 400DPI \*\*\*\*\* as the usual page printer with the same resolution and repeatability faithful except when printing an image with high resolution specially.

[0077] Moreover, according to the printer using the ion write head 16 of this example, although overwhelmingly excelled to the electrophotography method etc. in the repeatability of concentration gradation, in printing of an alphabetic character without gradation, the resolution of a print head becomes the factor which determines image quality. Although the resolution of the direction (main scanning direction) where the pixel of the line head as a print head is located in a line is decided by resolution of a print head The number of the individual electrodes 21 used as the number of the pixels in the ion write head 16 of this example It is easy to make it subdivide to the direction (the direction of vertical scanning) to which the latent-image support 28 or a printing medium moves (increment). In printing of an alphabetic character, the notch of the edge of the printed alphabetic character can be made smooth by making the number of the individual electrodes 21 in the ion write head 16 increase, and making resolution high.

[0078] Therefore, while the ion write head 16 of this example can make electrostatic latent-image formation generate the ion of only a complement on real time unlike the conventional ion write heads 1 and 1a by the corona discharge and high frequency discharge using high tension, integration of the actuation circuit 31 becomes easy, and while the price can miniaturize and fall certainly, resolution can be raised certainly.

[0079] Drawing 8 shows the 2nd example of the ion write head concerning this invention from drawing 5, drawing 5 is drawing of longitudinal section showing the configuration of an important section, drawing 6 is a gate electrode and the top view which excluded the insulating layer, drawing 7 is the sectional side elevation of drawing 6, and drawing 8 is the circuit diagram showing an actuation circuit.

[0080] Ion write head 16a of this example is taken as the configuration which carried out grouping of the individual electrode 21 while the individual electrode 21 of said 1st example serves as the function of



the heater layer 19.

[0081] As shown in drawing 5, the heating individual electrode layer 42 of the predetermined configuration for making the heater layer 19 and the individual electrode 21 of the 1st example which the heat insulating layer 18 is arranged on the substrate 17, and mentioned above ion write head 16a of this example in the top face of this heat insulating layer 18 serve a double purpose is arranged. And the conductive layer 23 is arranged in the top face of the heating individual electrode layer 42. Furthermore, the heating individual electrode layer 42 and the conductive layer 23 are etched into the same predetermined configuration. Moreover, the position of the conductive layer 23 on the heating individual electrode layer 42 is removed by etching etc., and, thereby, the heating unit 24 on which generation of heat of the heating individual electrode layer 42 is centralized to the electron emission section 22, and individual electrode 21a called the cathode electrode corresponding to resolution (pixel number) are formed. This individual electrode 21a is made into magnitude with a diameter of about 30 micrometers, and as shown in drawing 5 and drawing 6, alignment arrangement is carried out at the longitudinal direction (the print width direction) at the shape of a single tier. And the electron emission section 22 which may emit the electron for generating a charged particle (ion) is arranged in the top face of electrode 21 according to each a. Moreover, on the heat insulating layer 18, it centered on each electron emission section 22, for example, the gate electrode 26 which has the circular opening 25 with a diameter of about 20 micrometers is arranged through the insulating layer 27 of proper thickness, and it is formed in abbreviation plate-like as a whole.

[0082] As a raw material of said heating individual electrode layer 42, platinum, a tantalum, molybdenum, a tungsten, etc. are suitable.

[0083] That is, in ion write head 16a of this example, while the part which is not covered with the conductive layer 23 of the heating individual electrode layer 42 is set to individual electrode 21a, it is set to heating unit 24a for heating each electron emission section 22, and it has the composition that the electron emission section 22 is directly formed on individual electrode 21a. Moreover, as shown in drawing 6, grouping of the heating individual electrode layer 42 in this example is carried out so that four individual electrode 21a may become 1 set. It is not especially limited to the number of individual electrode 21a of this example that what is necessary is for resolution, a design concept, etc. of ion write head 16a just to determine the number of individual electrode 21a in this 1 group.

[0084] As shown in drawing 8, actuation circuit 31 of ion write head 16a of this example a is constituted so that time sharing of the electrode 21 according to each a may be carried out and it may be heated, and the power source VH for heating is connected to electrode 21 according to each a through the DC/DC conversion circuit 43 of an insulating mold, and the heater change-over circuit 44 as a switch for the on/off of every electrode 21 according to each a. And the heater change-over signal 46 which carries out on/off of the heater change-over circuit 44 through the photo coupler 45 corresponding to electrode 21 according to each a is inputted into the heater change-over circuit 44. Other configurations are the same as that of the actuation circuit 31 of the 1st example mentioned above.

[0085] By considering as such a configuration, this example By considering as the configuration which forms the electronic radiator 22 directly on individual electrode 21a which served as the heating unit 24, while doing so the same effectiveness as the 1st example mentioned above While a production process can be simplified, being able to reduce the number of production processes and being able to reduce an economic burden certainly Since a miniaturization can be attained and (the amount of accumulation) can be made small for heat capacity, the responsibility over a temperature change can be raised and heating time for the electron emission section 22 to emit an electron can be shortened. Moreover, since the medium insulating layer 20 in the 1st example can be excluded, there is no temperature gradient and the utilization effectiveness of heat can be raised certainly.

[0086] Drawing 11 is the top view showing the configuration of the important section which excluded the gate electrode and the insulating layer, drawing 13 shows the 3rd example of the ion write head concerning this invention from drawing 9, drawing 9 is drawing of longitudinal section showing the configuration of an important section, drawing 10 is the top view of drawing 9, and drawing 13 is [ drawing 12 is the sectional side elevation of drawing 11, and ] the circuit diagram showing an



actuation circuit.

[0087] Ion write head 16b of this example is taken as the configuration which divided the gate electrode 26 so that it might correspond to electrode 21 according to each a of said 2nd example.

[0088] Gate electrode 26a divided by the insulating layer 27 is arranged, and as shown in drawing 12 from drawing 9, ion write head 16b of this example is formed so that the configuration of the heating individual electrode layer 42 may also correspond to gate electrode 26a, so that it may correspond to electrode 21 according to each a formed in the heating individual electrode layer 42. Other configurations are the same as that of ion write head 16a of the 2nd example mentioned above.

[0089] As shown in drawing 13, while time sharing of the actuation circuit 31 of ion write head 16b of this example b is carried out and it heats each gate electrode 26a, it is constituted so that electrode 21 according to each a may be heated for every group, and the power source VL for latent-image writing is connected to each gate electrode 26a through the gate change-over circuit 47 as a switch for the on/off of each gate electrode 26a of every. He is trying for this gate change-over circuit 47 to operate with the gate change-over signal 48. Moreover, the power source VH for heating is connected to individual electrode 21a by which grouping was carried out per four pieces through the DC/DC conversion circuit 43 of an insulating mold. Other configurations are the same as that of actuation circuit 31a of the 2nd example mentioned above.

[0090] This example can do so the same effectiveness as the 2nd example mentioned above by considering as such a configuration.

[0091] Below, drawing 18 explains the structure of holding uniformly the distance G of the gate electrode 26A (a sign names generically the gate electrodes 26 and 26a) and the latent-image support 28 of each ion write head 16A (a sign names generically the ion write heads 16, 16a, and 16b) of this example, from drawing 14.

[0092] Drawing 14 shows the 1st example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support.

[0093] This example uses for a front face the dielectric drum 49 which has a dielectric layer 30 as latent-image support 28.

[0094] In this example, the proper contact rollers 50 and 50 are arranged in the both ends of the longitudinal direction which is the print width direction of ion write head 16A, and the dielectric drum 49 is arranged through these contact rollers 50 and 50. And they are contacted with the front face of the dielectric drum 49 while they are arranged free [ a revolution ], as each contact rollers 50 and 50 avoid the printing area of the front face of the dielectric drum 49. furthermore, the proper pressurization contacted with the support frame which ion write head 16A is supported free [ migration in the direction of the normal of the front face of the dielectric drum 49 ], and was arranged in the tooth back of ion write head 16A, and which is not illustrated -- it enables it to hold a predetermined distance (spacing) to the front face of the dielectric drum 49 with the thrust of a spring 51. In addition, contact pressure of each contact roller 50 may be made small, and the printing area of the dielectric drum 49 may be made to contact.

[0095] Drawing 15 shows the 2nd example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support.

[0096] In this example, like the 1st example shown in drawing 14, the contact roller 50 is not arranged in ion write head 16A, but the desired blade 52 as a cleaning means which makes the dielectric drum 49 at clarification the lower part of ion write head 16A is arranged instead. And the proper waste toner receptacle 53 is arranged at the lower part of a blade 52. Moreover, he is trying to touch the dielectric drum 49 with the record media 55, such as a form, in imprint / fixation section 54 caudad shown in drawing 15.

[0097] By such configuration as well as the 1st example which is shown in drawing 14 and which was mentioned above, the distance of the gate electrode 27A and the latent-image support 28 of ion write head 16A can be held uniformly.

[0098] Drawing 16 shows the 3rd example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support, (a) is a perspective view and (b) is drawing of

longitudinal section.

[0099] The dielectric belt 56 of the shape of an endless belt which has flexibility as latent-image support 28 is used for this example.

[0100] The proper belt attachment component 57 is arranged in ion write head 16A, the dielectric belt 56 is positioned to ion write head 16A, and the distance of gate electrode 26A which ion write head 16A does not illustrate, and the front face of the dielectric belt 56 is made to \*\* uniformly in this example. In this case, it is important to set thickness of the dielectric belt 56 constant.

[0101] Since the location of ion write head 16A is easily fixable as compared with the configuration using the dielectric drum 49 shown in drawing 14 and drawing 15 according to such a configuration, it is advantageous when holding uniformly the distance of the gate electrode 27A and the latent-image support 28 of ion write head 16A.

[0102] Drawing 17 shows the 4th example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support.

[0103] This example uses the dielectric belt 56 as latent-image support 28 like the 3rd example shown in drawing 16.

[0104] It pushes against the belt attachment component 57a side which arranged the front face of the dielectric belt 56 so that the front face of ion write head 16A might be covered, and distance is made to hold uniformly in this example. And it forms in belt attachment component 57a of this example by the insulating layer 59 which consists of a proper insulator so that the electrostatic latent image formed in the front face of the dielectric belt 56 in the downstream front face 58 of ion write head 16A may not be disturbed. In addition, while making the downstream front face 58 of ion write head 16A not contact the front face of the dielectric belt 56, the conductive layer 61 which becomes the inlet face 60 of ion write head 16A from a conductive ingredient is formed, and it may be made to discharge the dielectric belt 56.

[0105] Drawing 18 shows the 5th example of the structure of holding uniformly the gate electrode of the ion write head, and the distance of latent-image support.

[0106] This example makes the structure of the 4th example shown in drawing 17 inject a fluid (air) toward the dielectric belt 56 from the front face of ion write head 16A, and it is made to surface the dielectric belt 56 in fixed height from the front face of ion write head 16A.

[0107] In this example, it prepares in each [ the proper orifice 63 for maintaining the balance of the flow rate of the air which flows each nozzle 62 while forming two or more nozzles 62 is connected / each / front face / of head attachment component 55a / at each nozzle 62 ] passage 64, and supply of application-of-pressure air is enabled to each passage 64. In addition, the flying height to ion write head 16A of the dielectric belt 56 is good to be referred to as about 50 micrometers.

[0108] According to such a configuration, the dielectric belt 56 is not influenced of the conductive existence of the front face of ion write head 16A in order not to contact ion write head 16A. Moreover, since the toner which adheres to the front face of the dielectric belt 56 with the pressure of air and which is not illustrated can be eliminated outside, the inconvenience that a toner adheres to the electron emission section can also be prevented certainly.

[0109] Below, drawing 21 explains the printer which used ion write head 16A of this example from drawing 19.

[0110] Drawing 19 shows the 1st example of the printer concerning this invention.

[0111] The dielectric drum 49 is used for the printer 65 of this example as latent-image support 28.

[0112] As shown in drawing 19, the printer 65 of this example The dielectric drum 49 is arranged free [ a revolution ] by the clockwise rotation shown by the arrow head in drawing 19. Ion write head 16A as latent-image means forming which forms in the perimeter of this dielectric drum 49 clockwise the electrostatic latent image corresponding to the image of the request which is not illustrated on the dielectric drum 49 from the upper part in drawing 19, The proper development counter 66 as a development means to develop with the toner which does not illustrate an electrostatic latent image, The application-of-pressure roller 67 as an imprint fixation means by which it is established while imprinting the electrostatic latent image which the toner developed on the record media 55, such as a form, The



cleaner 69 which has the proper metal blade 68 as a cleaning means which makes the dielectric drum 49 clarification, and proper AC electric discharge machine 70 as an electric discharge means to remove the electrification condition of the dielectric drum 49 are arranged in order, and are formed.

[0113] The toner (not shown) of the same plus electrification as the normal development using the photo conductor of minus electrification is used for said development counter 66, and it is used especially for the sleeve 71 of a development counter 66 with touch-down potential, without applying bias voltage.

[0114] Moreover, an imprint and fixation make the contact force of a request of the application-of-pressure roller 67 have and contact the dielectric drum 49, and push a record medium 55 against the dielectric drum 49, and the pressure of said contact pressure performs them simultaneously. While fixation becomes possible by this, without using a heat fixing assembly and decreasing power consumption, warm-up time can be made unnecessary.

[0115] Moreover, although the blade (not shown) of the cleaner used for the conventional electrophotography is made into the product made of rubber since a photo conductor (not shown) tends to get damaged, since the blade 68 of the cleaner 69 of the printer 65 of this example has the high reinforcement of the dielectric drum 49, a metal thing can be used for it, and it can raise the precision of a blade 68, and endurance certainly. And for electric discharge of the dielectric drum 49, AC electric discharge machine 70 can neutralize the charge of the front face of the dielectric drum 49 efficiently using the ion of the amphipathy of plus and minus.

[0116] According to the printer 65 of this example which consists of such a configuration, while being able to obtain a high-definition quality of printed character with the conjointly very high repeatability of gradation with the effectiveness of ion write head 16A mentioned above, it can use for various applications.

[0117] Drawing 20 shows the 2nd example of the printer using the head concerning this invention.

[0118] The dielectric belt 56 is used for printer 65a of this example as latent-image support 28.

[0119] as shown in drawing 20, while being supported free [ a revolution ] in printer 65a of this example -- up and down -- alienation -- two rollers 72 and 73 made into the condition are arranged, either of the rollers 72 and 73 is used as a drive roll, and another side is considered as the follower roll. And as the peripheral face of each roller 72 and 73 is contacted, the dielectric belt 56 is wound. Furthermore, transit of the dielectric belt 56 in the direction shown by the arrow head in drawing 20 with said each rollers 72 and 73 is enabled.

[0120] Ion write head 16A as latent-image means forming which forms in the method of the lower left of said dielectric belt 56 the electrostatic latent image corresponding to the image of the request which is not illustrated is arranged. And the proper development counter 66 as a development means to develop to the method of the lower right of the dielectric belt 56 with the toner which does not illustrate an electrostatic latent image is arranged. Furthermore, the proper cleaner 69 as a cleaning means which carries out clarification of the dielectric belt 56 is arranged at the up left of the dielectric belt 56.

Moreover, between ion write head 16A and a cleaner 69, proper AC electric discharge machine 70 as an electric discharge means to remove the electrification condition of the front face of the dielectric belt 56 as it counters with the dielectric belt 56 is arranged.

[0121] The ion generator 74 as electrostatic image transfer which imprints the electrostatic latent image which the horizontal left shown by the arrow head in drawing 20 developed with the toner through the record medium 55 whose transit was enabled on a record medium is arranged in the upper part of said dielectric belt 56. This ion generator 74 is made into the structure of having the same electron emission section 22 as ion write head 16A.

[0122] Moreover, the fixing roller 75 as a fixation means to fix a toner to a record medium 55 according to an operation of heat, and the application-of-pressure roller 76 which has elasticity enable pinching of a record medium 55, and is arranged at the transit direction downstream of a record medium 55.

[0123] According to printer 65a of this example which consists of such a configuration, the same effectiveness as the printer 65 of the 1st example mentioned above is done so. And the structure of the ion generator 74 used for the electrostatic image transfer of this example does not have the need for image formation, and since there are also few homogeneous demands of a current, the number of the



electron emission sections 22 can be reduced, or it can enlarge distance between the ion generator 74 and the dielectric belt 56. Furthermore, since the toner to a record medium 55 is established with a fixing roller 75 and the application-of-pressure roller 76, generating of the gloss of the record medium 55 by crushing the record medium 55 and toner at the time of using the application-of-pressure roller 67 of the printer 65 of the 1st example mentioned above by the high pressure and a toner can be prevented certainly, and a more nearly high-definition quality of printed character can be obtained. Moreover, since the ion generator 74 has the high consistency of the generated ion compared with the generating means of other ion, such as corotron which is not illustrated, an imprint field is limited, and the ion generator 74 can prevent degradation of the image by imprint certainly while miniaturizing like ion write head 16A and being able to operate it with a low battery and a low power. Furthermore, the ion generator 74 is the same polarity as ion write head 16A, and since it can be made to operate with few currents, the power source of the actuation circuit which ion write head 16A does not illustrate can be shared. This can decrease an economic burden certainly while being able to attain certainly the miniaturization of the actuation circuit of the whole printer 65a, equipment (not shown), etc.

[0124] Drawing 21 shows other examples of the printer which used the dielectric belt as latent-image support.

[0125] The ion generator 74 as electrostatic image transfer which imprints the electrostatic latent image which the toner developed like printer 65a of the 2nd example mentioned above in printer 65b of this example on a record medium 55 is not arranged. As an imprint fixation means fixed while imprinting a toner to a record medium 55 instead, as a fixing roller 75 and the application-of-pressure roller 76 pinch dielectric belt 56a formed with heat-resistant raw materials, such as polyimide, they are arranged. This fixing roller 75 caudad Two rollers 72 and 73 are arranged at parallel at right and left, and as said dielectric belt 56a contacts each peripheral face of said fixing roller 75 and two rollers 72 and 73, it is wound around it.

[0126] Ion write head 16A as latent-image means forming which forms in the lower part of said dielectric belt 56a the electrostatic latent image corresponding to the image of the request which is not illustrated is arranged, and the proper development counter 66 as a development means to develop to the method of the lower right of dielectric belt 56a with the toner which does not illustrate said electrostatic latent image is arranged. Furthermore, the proper cleaner 69 as a cleaning means which makes dielectric belt 56a clarification is arranged at the method of the lower left of dielectric belt 56a, and proper AC electric discharge machine 70 as an electric discharge means to remove the electrification condition of dielectric belt 56a as the upper part is countered with dielectric belt 56a is arranged.

[0127] While doing so the same effectiveness as printer 65a of the 2nd example mentioned above according to printer 65b of this example which consists of such a configuration, \*\*\*\* of the image at the time of an imprint can be prevented more certainly, and a more nearly high-definition quality of printed character can be obtained, and a miniaturization can be attained easily. In addition, the heater element of a single dimension like a thermal head or a 2-dimensional heating element can also be used instead of a fixing roller 75.

[0128] Moreover, this invention is not limited to said each example, and the combination of said each ion write heads 16, 16a, and 16b, said individual electrodes 21 and 21a, and each of said actuation circuits 31, 31a, and 31b can be chosen from the thing of various kinds of combination that what is necessary is for a design concept just to determine.

[0129] This invention is not limited to said each example, and can be changed further again if needed.

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[Translation done.]

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] Drawing of longitudinal section showing the configuration of the important section of the 1st example of the ion write head concerning this invention

[Drawing 2] Drawing 1 is a cutting top view a part.

[Drawing 3] The circuit diagram showing the actuation circuit of the 1st example of the ion write head concerning this invention

[Drawing 4] (j) is an explanatory view explaining the production process of the 1st example of the ion write head concerning this invention from (a).

[Drawing 5] Drawing of longitudinal section showing the configuration of the important section of the 2nd example of the ion write head concerning this invention

[Drawing 6] The top view which excluded the gate electrode and insulating layer of the 2nd example of the ion write head concerning this invention

[Drawing 7] The sectional side elevation of drawing 6

[Drawing 8] The circuit diagram showing the actuation circuit of the 2nd example of the ion write head concerning this invention

[Drawing 9] Drawing of longitudinal section showing the configuration of the important section of the 3rd example of the ion write head concerning this invention

[Drawing 10] The top view showing the configuration of the important section of the 3rd example of the ion write head concerning this invention

[Drawing 11] The top view showing the configuration of the important section which excluded the gate electrode and insulating layer of the 3rd example of the ion write head concerning this invention

[Drawing 12] Drawing 12 is the sectional side elevation of drawing 11.

[Drawing 13] The circuit diagram showing the actuation circuit of the 3rd example of the ion write head concerning this invention

[Drawing 14] The perspective view of an important section showing the 1st example of the structure of holding uniformly the gate electrode of the ion write head and the distance of latent-image support concerning this invention

[Drawing 15] The side elevation of an important section showing the 2nd example of the structure of holding uniformly the gate electrode of the ion write head and the distance of latent-image support concerning this invention

[Drawing 16] The 3rd example of the structure of holding uniformly the gate electrode of the ion write head and the distance of latent-image support concerning this invention is shown, (a) is a perspective view and (b) is drawing of longitudinal section.

[Drawing 17] Drawing of longitudinal section of an important section showing the 4th example of the structure of holding uniformly the gate electrode of the ion write head and the distance of latent-image support concerning this invention

[Drawing 18] Drawing of longitudinal section of an important section showing the 5th example of the structure of holding uniformly the gate electrode of the ion write head and the distance of latent-image

support concerning this invention

[Drawing 19] Structural drawing showing the configuration of the important section of the 1st example of a printer using the ion write head concerning this invention

[Drawing 20] Structural drawing showing the configuration of the important section of the 2nd example of a printer using the ion write head concerning this invention

[Drawing 21] Structural drawing showing the configuration of the important section of the 3rd example of a printer using the ion write head concerning this invention

[Drawing 22] It is the explanatory view in which the perspective view in which (a) shows the whole configuration, drawing of longitudinal section in which (b) shows the configuration of an important section, and (c) show the arrangement condition of a line electrode and a finger electrode by showing an example of the conventional ion write head.

[Drawing 23] The mimetic diagram showing other examples of the conventional ion write head

[Description of Notations]

16, 16a, 16b, 16A Ion write head

17 Substrate

18 Heat Insulating Layer

19 Heater Layer

21, 21a, an individual electrode

22 Electron Emission Section

23 Conductive Layer

24 24a Heating unit

25 Opening

26, 26a, 26A Gate electrode

27 Insulating Layer

31, 31a, 31b Actuation circuit

42, a heating individual electrode layer

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[Translation done.]



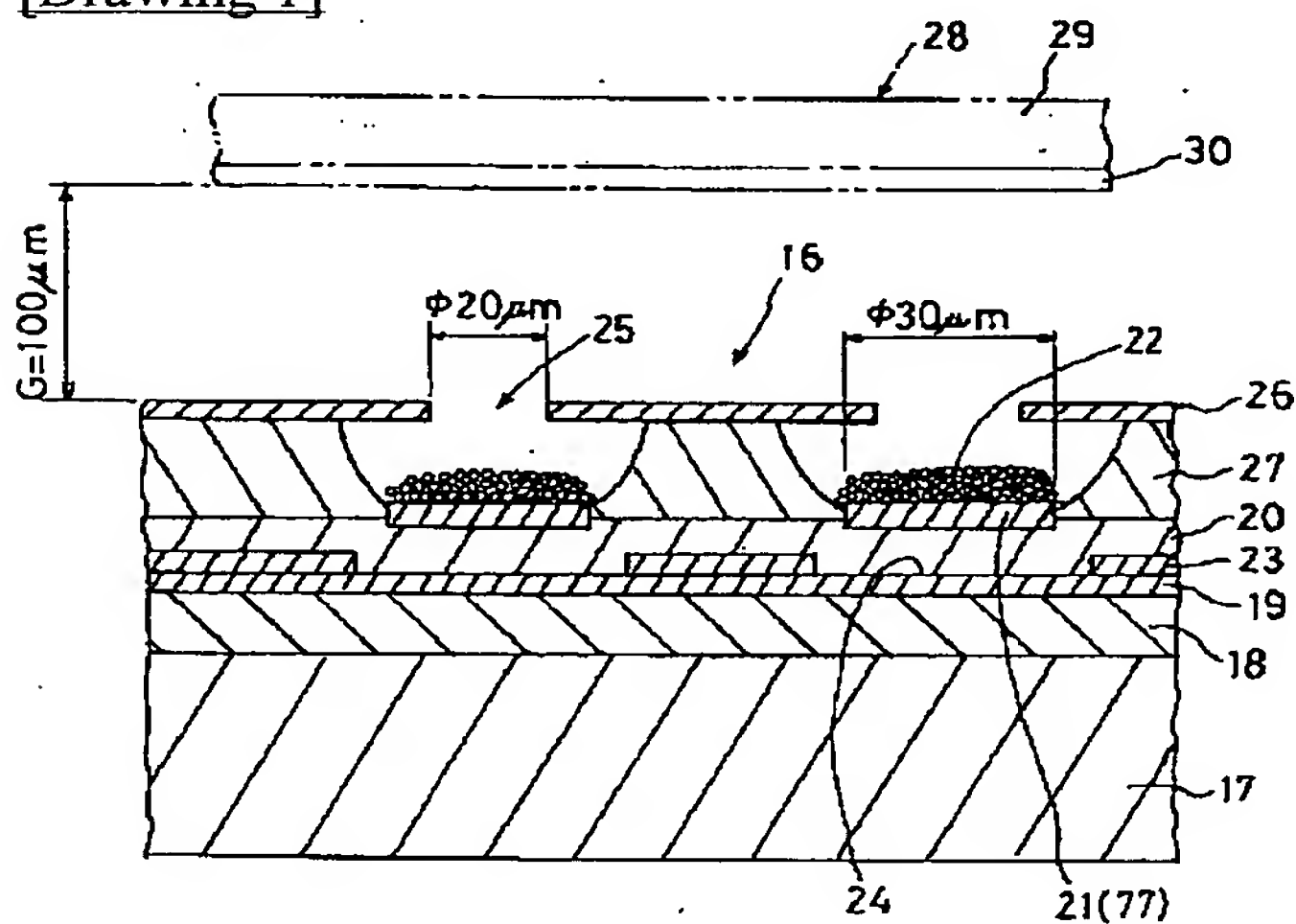
## \* NOTICES \*

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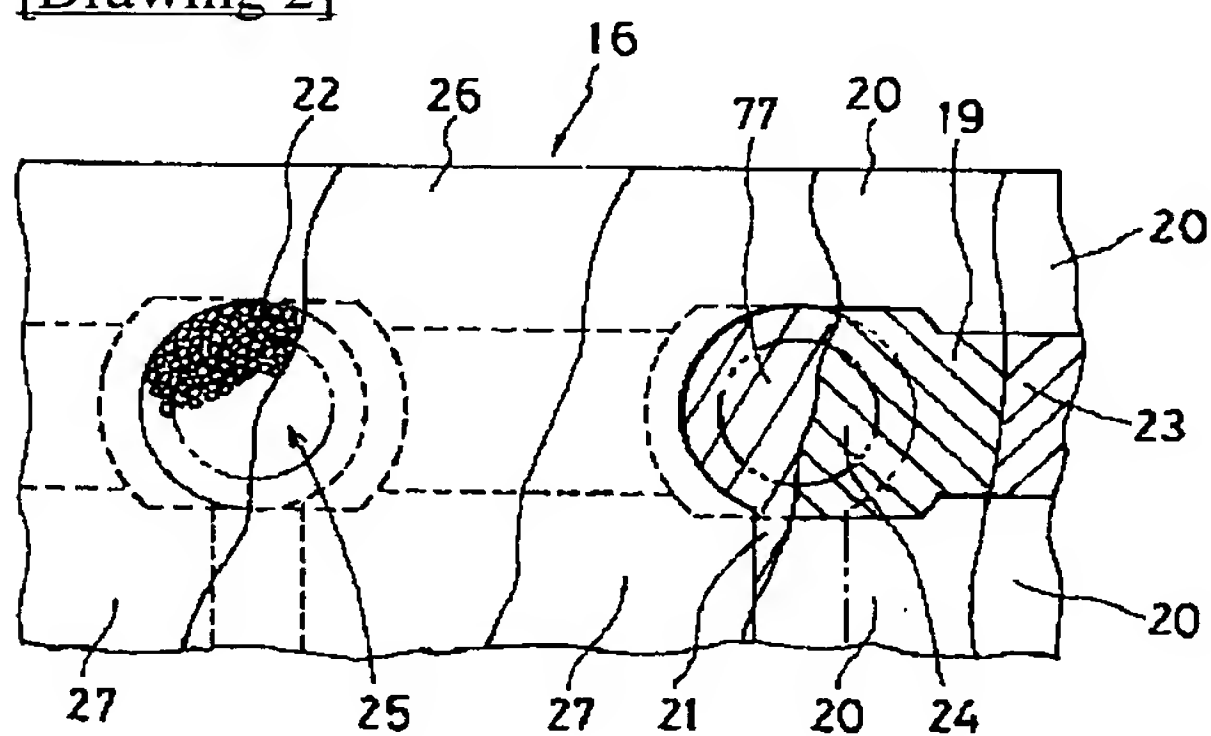
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2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

## DRAWINGS

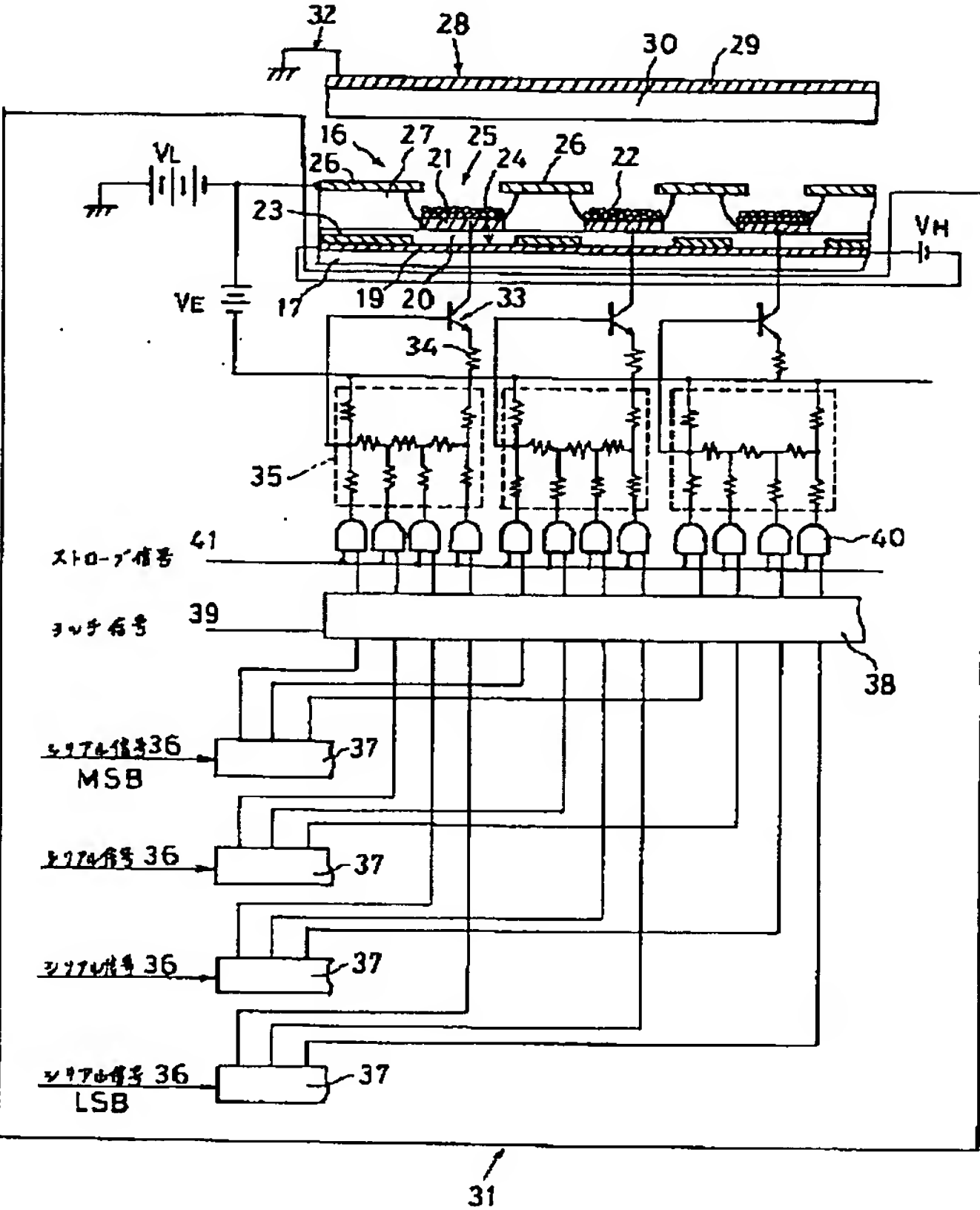
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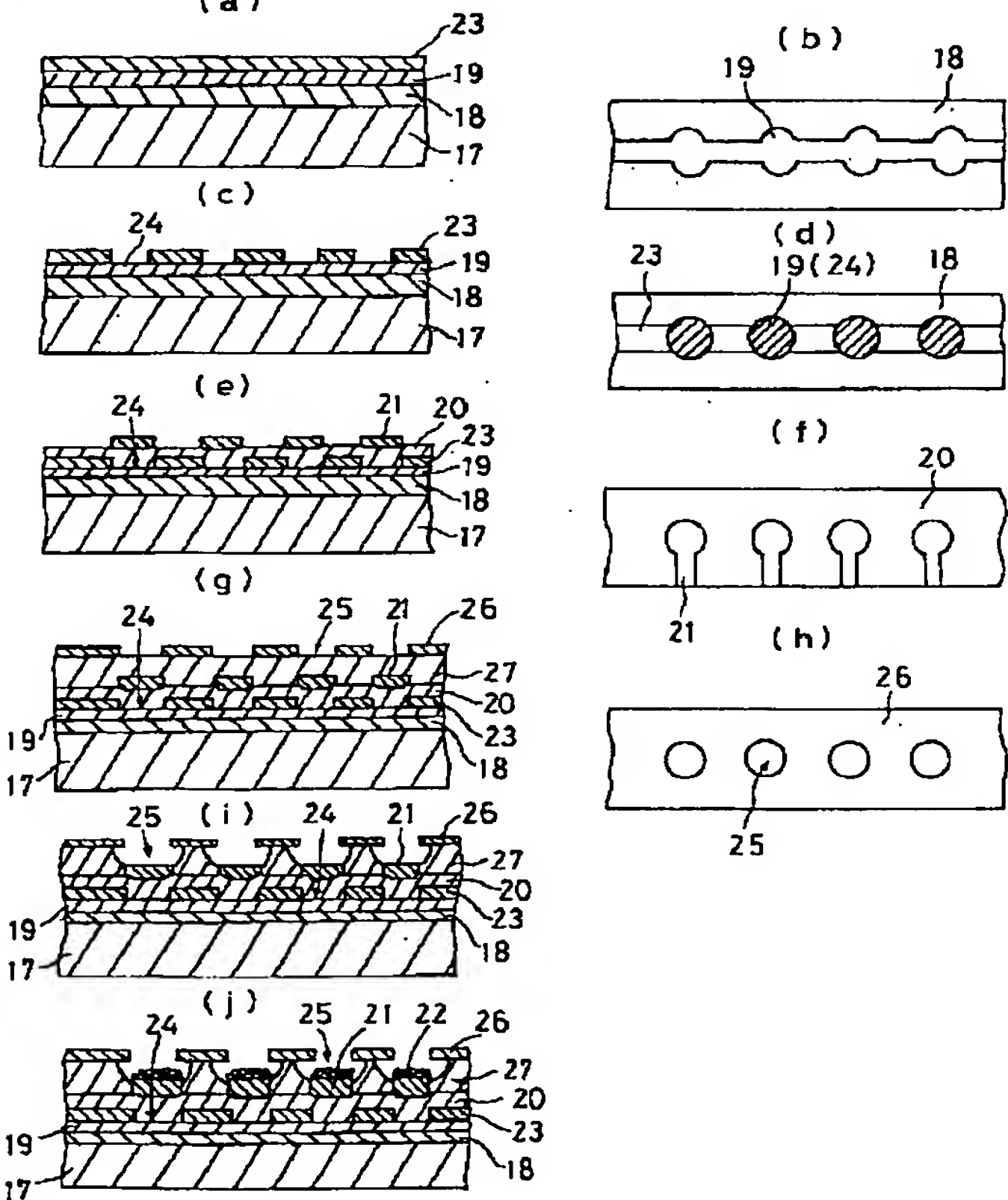
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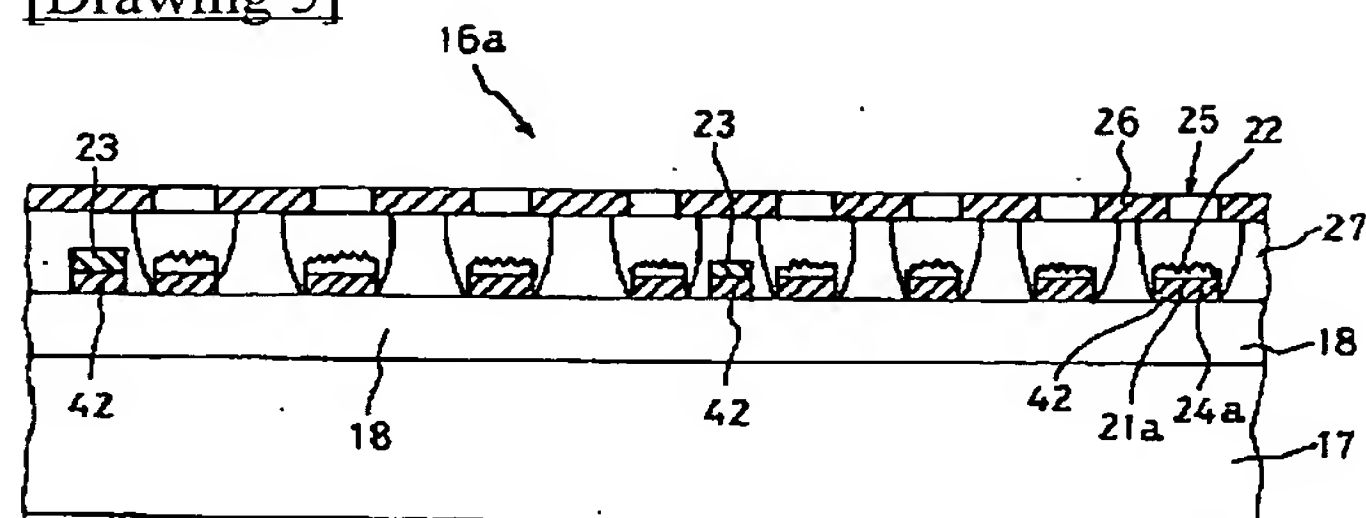
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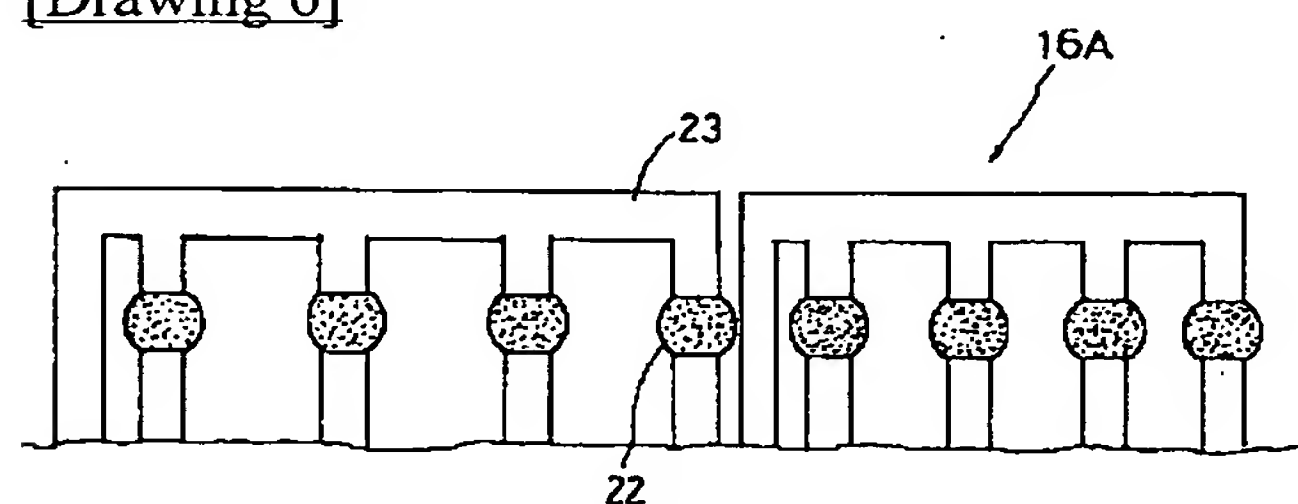
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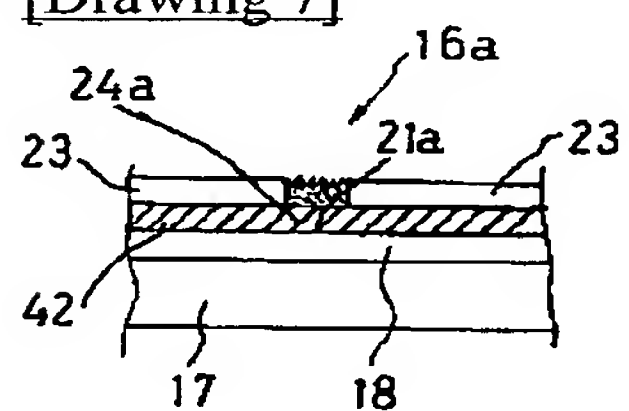
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[Drawing 6]

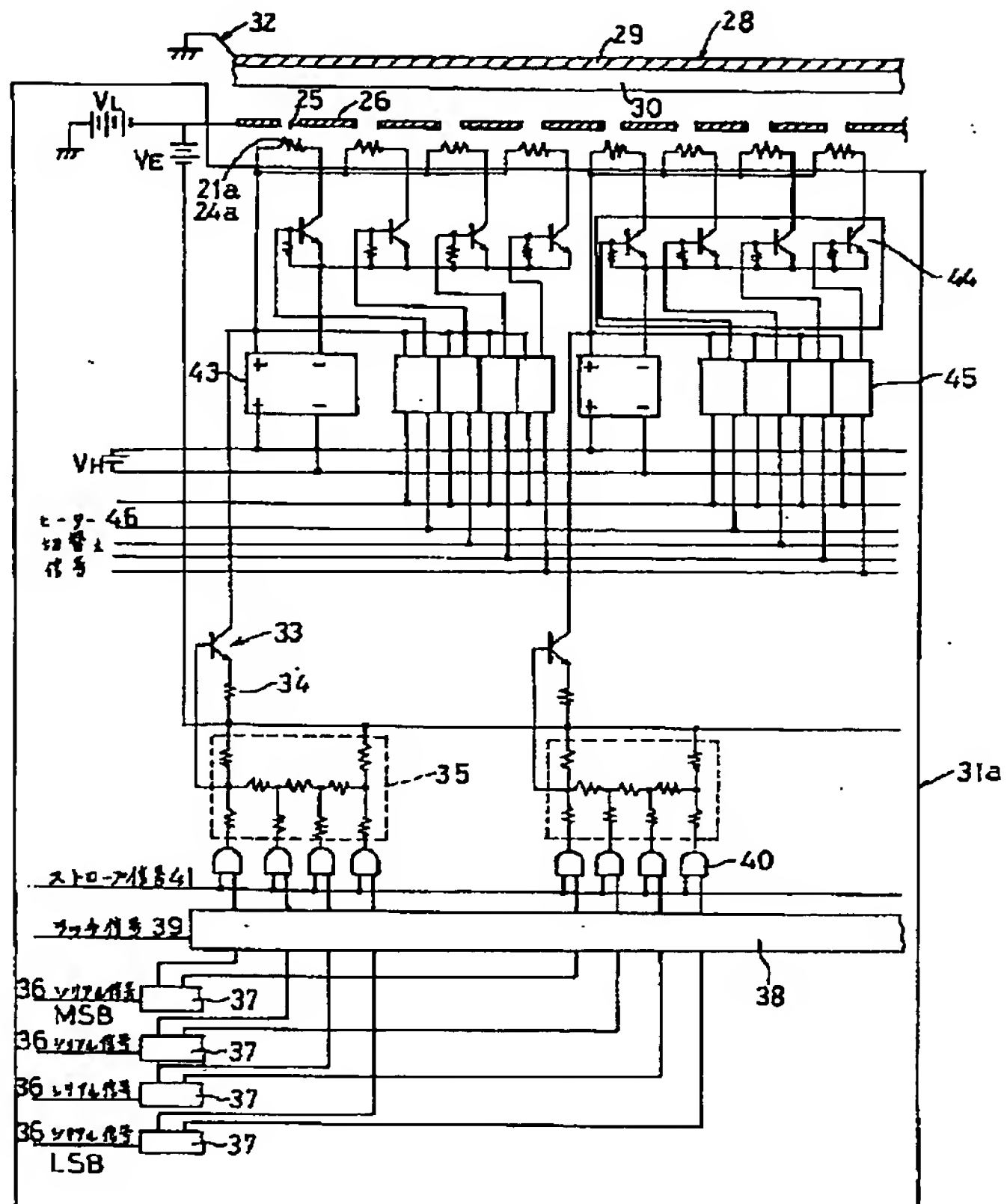


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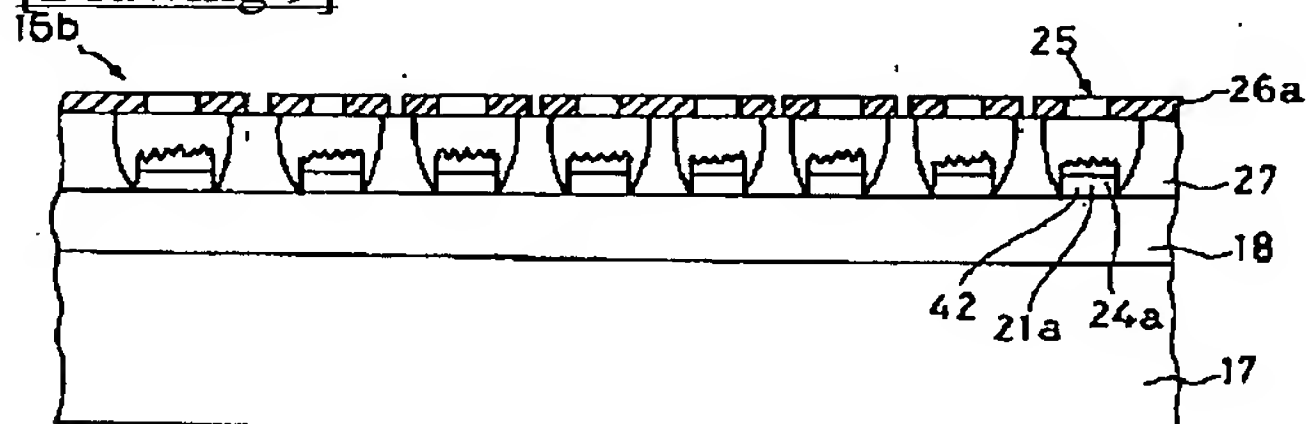


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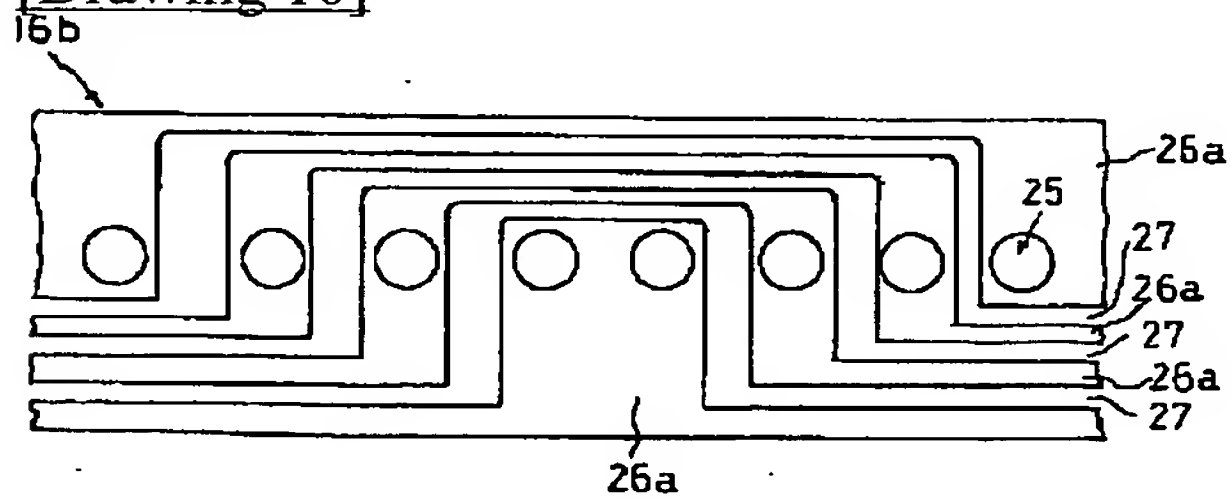




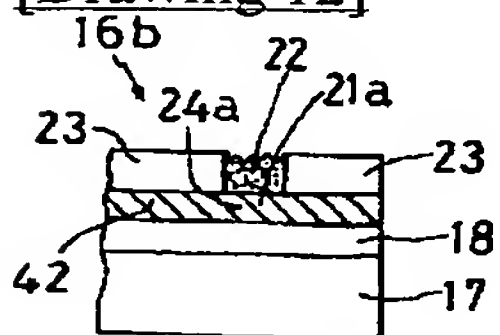
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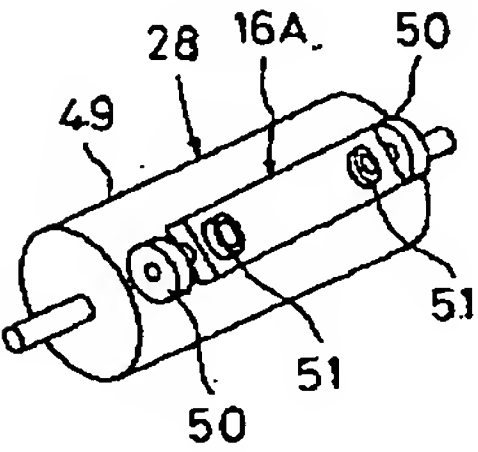
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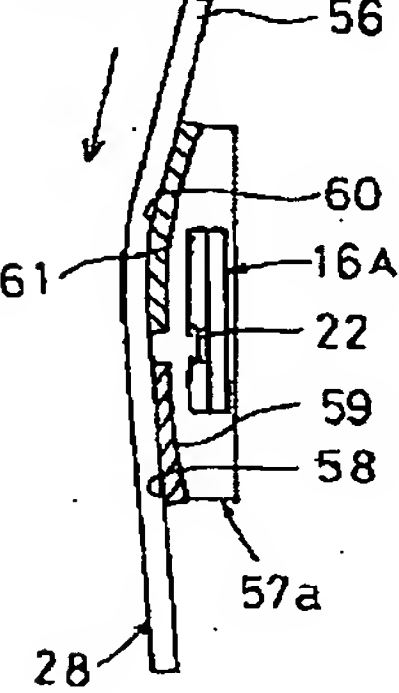
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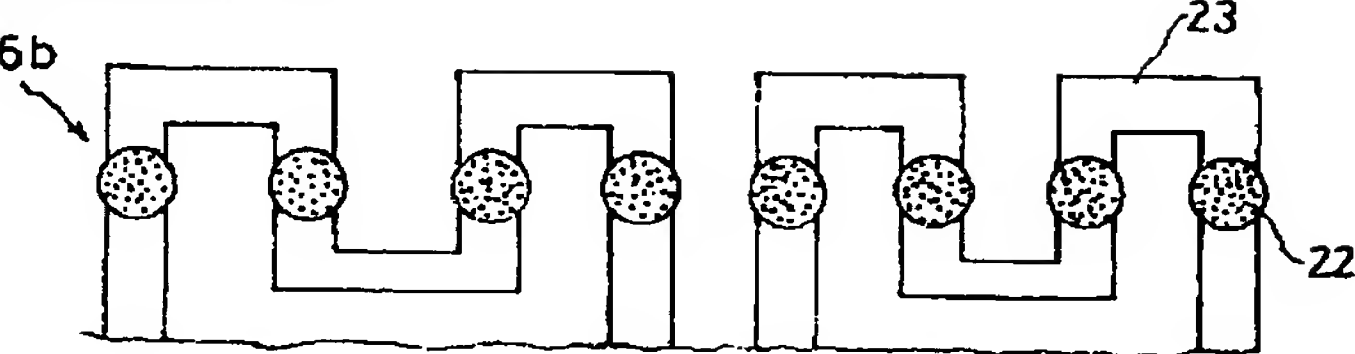
[Drawing 14]



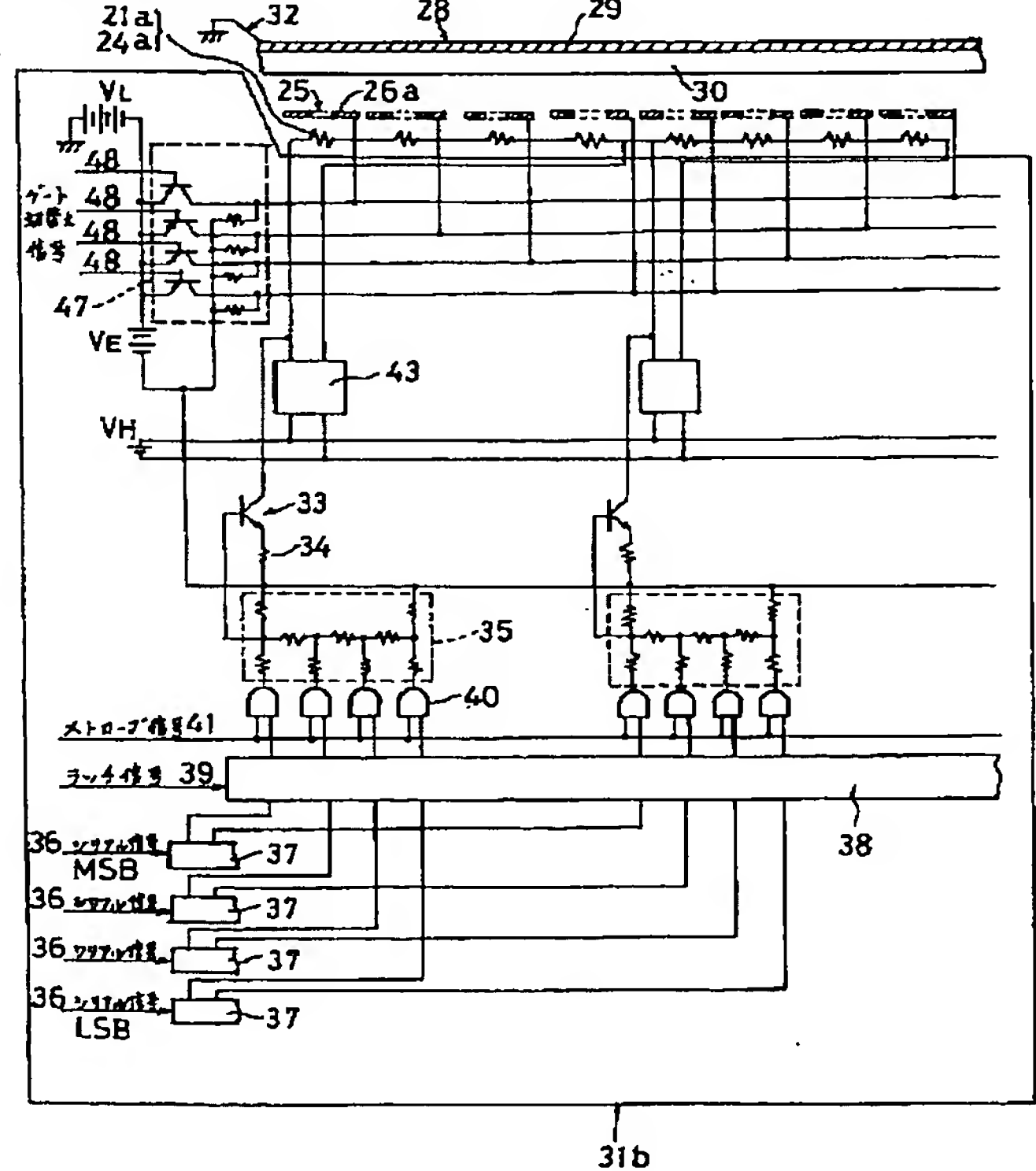
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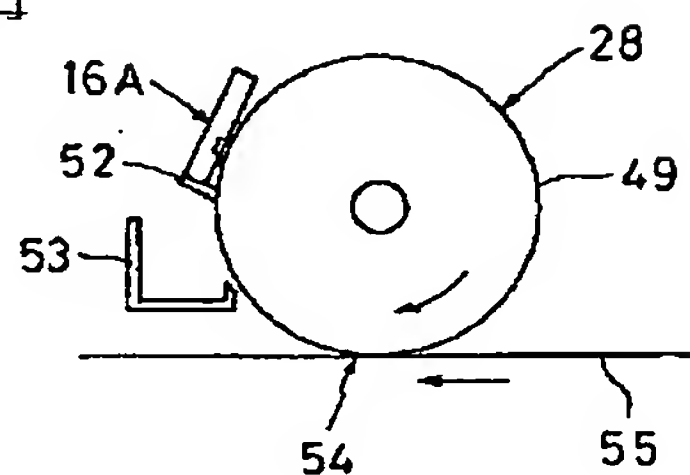
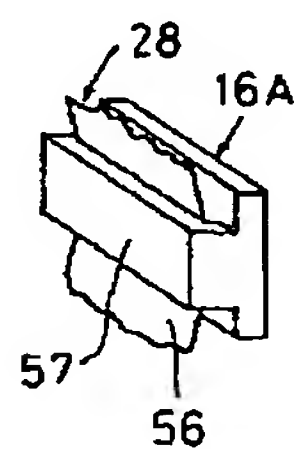
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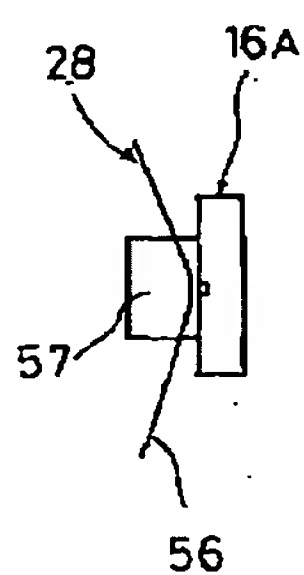
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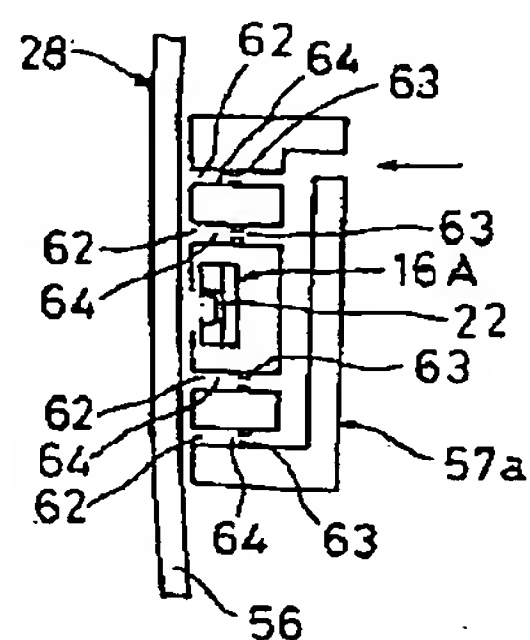
[Drawing 15]

[Drawing 16]  
(a)

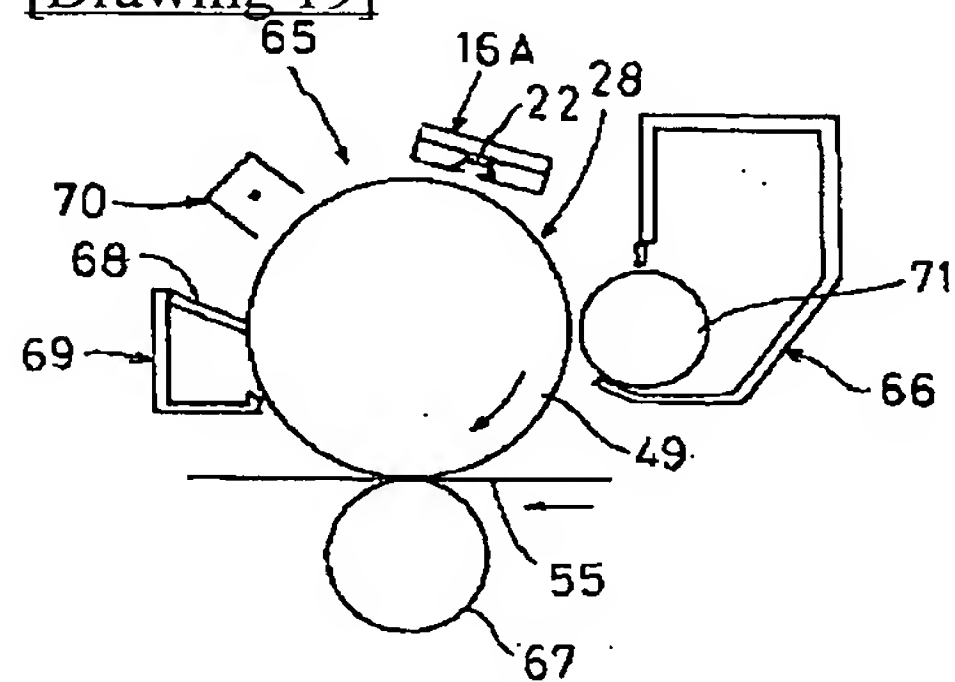
(b)



[Drawing 18]

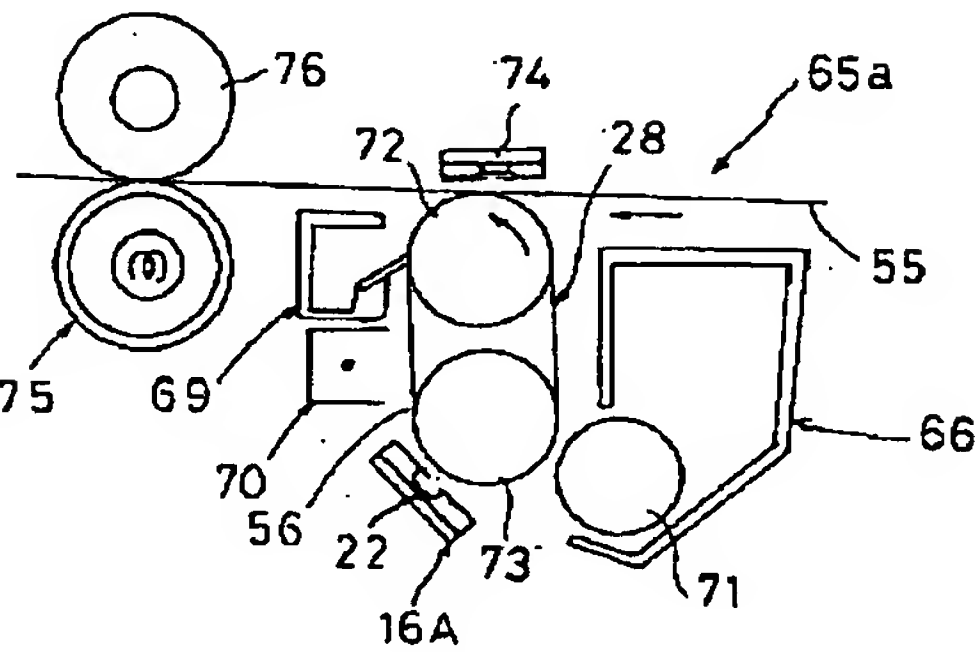


[Drawing 19]

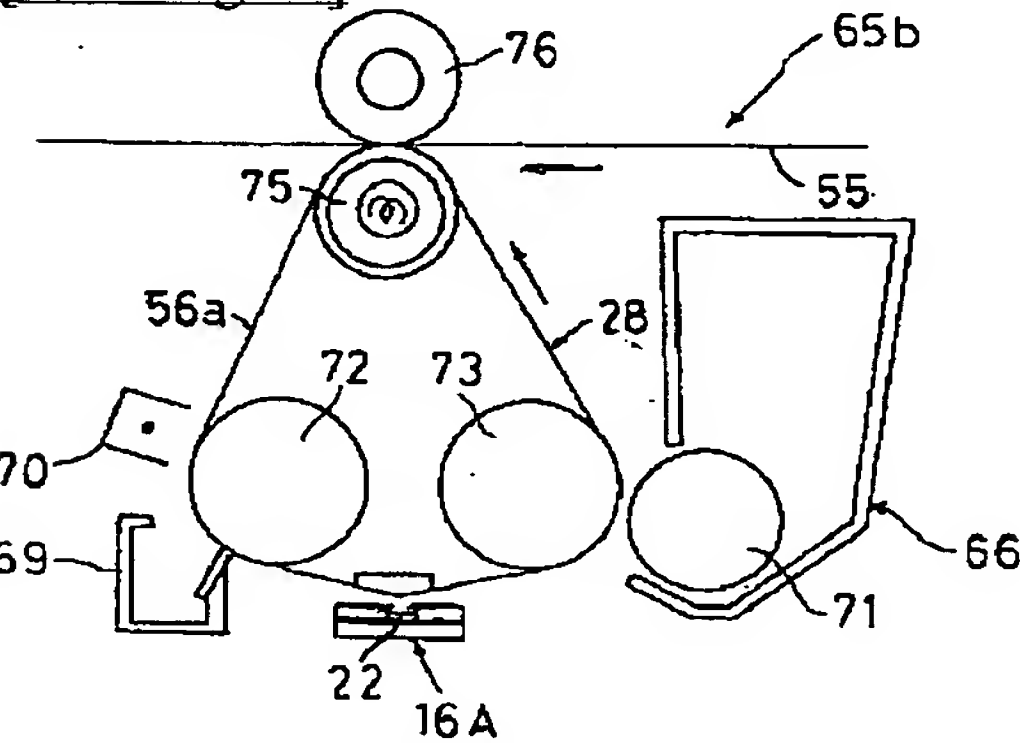


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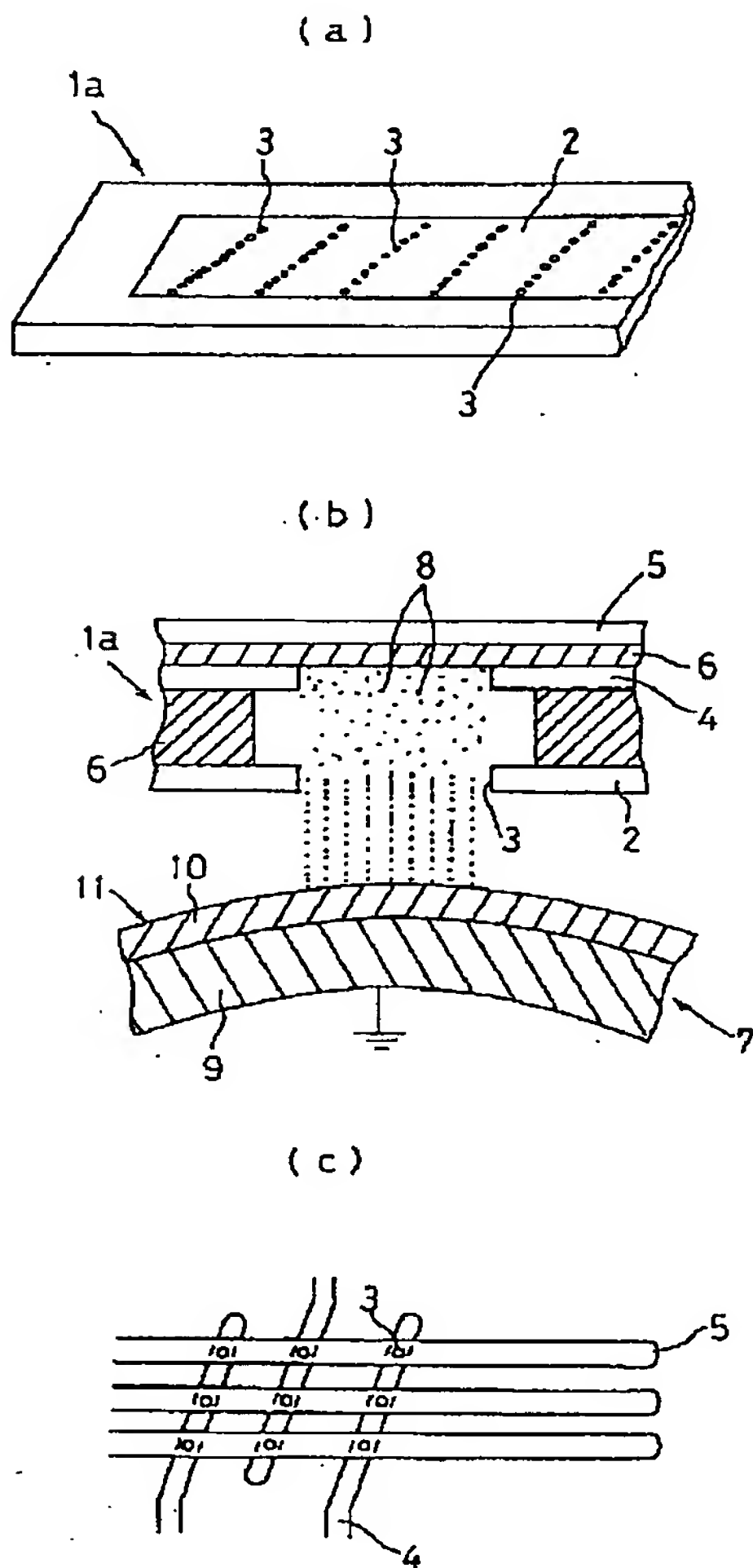




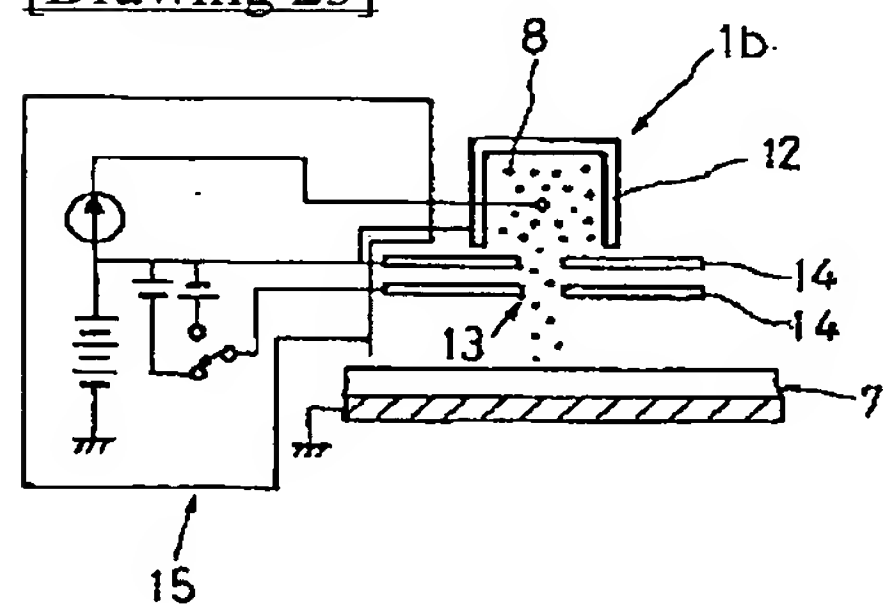
[Drawing 21]



[Drawing 22]



[Drawing 23]



[Translation done.]

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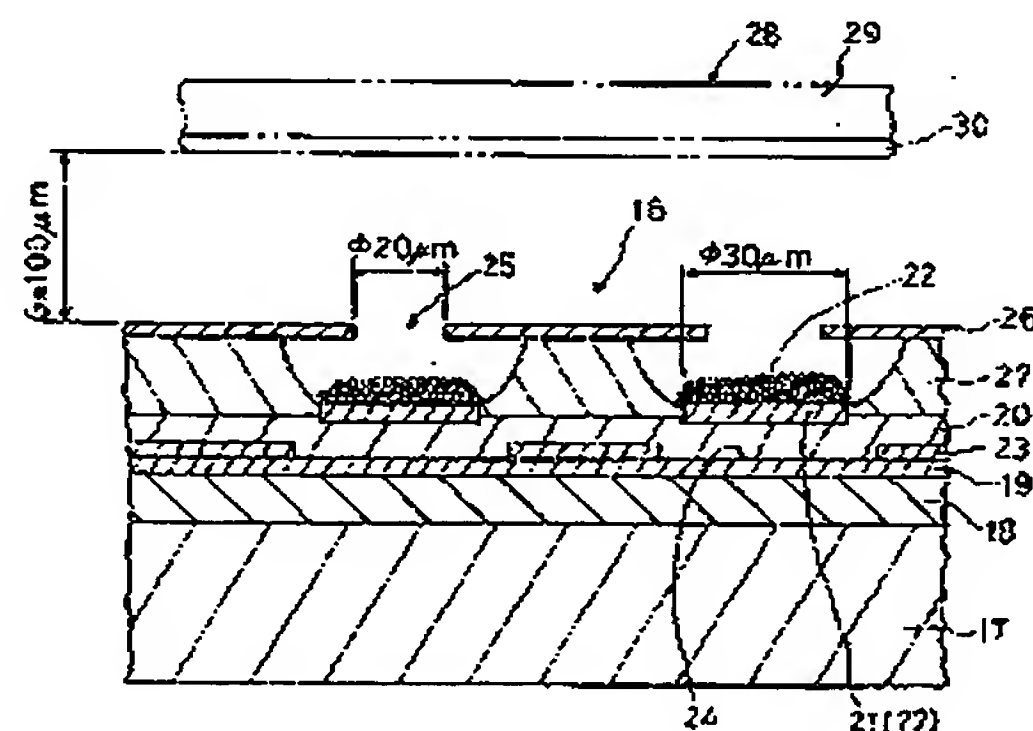
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(54) 【発明の名称】 イオン書き込みヘッド

(57) 【要約】

【目的】 小型で、イオンの利用効率の高いイオン書き込みヘッドを提供すること。

【構成】 誘電体により構成される潜像担持体28上に荷電粒子を選択的に付着させて静電潜像を形成するイオン書き込みヘッド16であって、基板17上に形成された複数の個別電極21と、前記個別電極21上に形成され加熱されることにより荷電粒子を生成するための電子を放出し得る電子放出部22と、前記電子放出部22を加熱するための加熱部24と、前記個別電極21と協働して前記電子放出部22から放出された電子を加速するためのゲート電極26とを有することを特徴としている。





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## 【特許請求の範囲】

【請求項1】 誘電体により構成される潜像担持体上に荷電粒子を選択的に付着させて静電潜像を形成するイオン書込みヘッドであって、基板上に形成された複数の個別電極と、前記個別電極上に形成され加熱されることにより荷電粒子を生成するための電子を放出し得る電子放出部と、前記電子放出部を加熱するための加熱部と、前記個別電極と協働して前記電子放出部から放出された電子を加速するためのゲート電極とを有することを特徴とするイオン書込みヘッド。

【請求項2】 前記個別電極が前記加熱部を兼用することを特徴とする請求項1に記載のイオン書込みヘッド。

【請求項3】 前記電子放出部が誘電体を主体として形成されていることを特徴とする請求項1または請求項2に記載のイオン書込みヘッド。

【請求項4】 前記加熱部を所定のタイミングで発熱させる駆動回路を有することを特徴とする請求項1乃至請求項3の何れか1項に記載のイオン書込みヘッド。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】本発明は、誘電体により構成される潜像担持体上に外部から画像に対応した荷電粒子を選択的に付着させて静電潜像を形成する静電記録装置等に好適なイオン書込みヘッドに関する。

## 【0002】

【従来の技術】近年、従来の電子写真方式において潜像担持体として用いられている感光体と比較して、潜像担持体の機械的な強度が高く、湿度や繰り返しに対する安定性も優れている誘電体により形成される潜像担持体を用いるとともに、従来の光に代わって荷電粒子（イオン）を用いて静電潜像の形成を行なうイオン書込み式の印字装置が、高速で印字枚数が非常に多く、メンテナンスの頻度の少ない業務用高速印字装置等に多用されている。そして、イオン書込み式の印字装置は、感光体を用いた電子写真方式の印字装置と比較して潜像電位の制御が容易なため、トナー等の現像剤の付着量を制御することにより濃度階調を有する印字に適しており、濃度階調の再現性が重視されるフルカラーの印字装置等に適している。

【0003】以下、このような従来のイオン書込みヘッドについて説明する。

【0004】図22は従来のイオン書込みヘッドの一例を示すものであり、(a)は全体の形状を示す斜視図であり、(b)は要部の構成を示す縦断面図であり、

(c)はライン電極とフィンガー電極との配置状態を示す説明図である。

【0005】図22の(a)に示すように、従来のイオン書込みヘッド1aは、一方の表面にスクリーン電極2が設けられ、その表面に複数の開口3が鋸歯状に配列して形成されており、全体として略平板状とされている。

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そして、図22の(b)に示すように、スクリーン電極2と、開口3を持つフィンガー電極4と、ライン電極5とがそれぞれ所望の誘電体からなる絶縁層6を介して配設されている。また、図22の(c)に示すように、フィンガー電極4の開口3とライン電極5とは、マトリクス状に配置されている。そして、図22の(b)に示すように、イオン書込みヘッド1aは各開口3を潜像担持体7に対向するようにして配設されている。

【0006】このような従来のイオン書込みヘッド1aにおいては、フィンガー電極4とライン電極5との間に、図示しない所望の駆動回路により、例えば、周波数1MHz、電圧1kV程度の高周波電圧を印加し、フィンガー電極4の周辺の大気中に放電による荷電粒子としてのイオン8（図22の(b)）を発生させるようになっている。また、図22の(c)に示すように、ライン電極5は複数個設けられており、順次その一つに高周波電圧が印加されるようになっている。そして、スクリーン電極2には、-600Vの直流電圧が印加され、フィンガー電極4には待機時に-700V、印字時に-400Vの電圧が印加されるようになっている。さらに、印字時のパルス幅は、例えば、20μs程度とされ、フィンガー電極4の周辺の大気中に発生した、例えば、マイナスの極性のイオン8をスクリーン電極2により制御し、図22の(b)に示すように、開口3を通して潜像担持体7に衝突させるようになっている。

【0007】前記潜像担持体7は、図22の(b)に示すように、金属ドラム9の表面に所望の誘電体層10が形成されたいわゆる誘電体ドラム11とされ、前記金属ドラム9は接地されている。そして、前述したように、荷電粒子としてのマイナスの極性のイオン8を誘電体ドラム11の表面に衝突させることにより、図示しない所望の画像に対応した静電潜像を誘電体ドラム11の表面に形成するようになっている。

【0008】図23は他の例の従来のイオン書込みヘッド1bを示すものであり、この従来のイオン書込みヘッド1bにおいては、荷電粒子としてのイオン8の発生にコロトロン12を用いており、その前面に所望の複数の開口13を有する二枚の制御電極14、14が配置され、適宜な駆動回路15により駆動されるようになっている。そして、二枚の制御電極14、14の間に加える電圧の極性により、コロトロン12にて発生させたイオン8、例えば、プラス極性のイオン8が開口13から潜像担持体7へ到達させるか否かを制御するようにされている。また、二枚の制御電極14、14の間の距離は、例えば、100μm程度とされ、開口13の直径は200μm程度とされている。さらに、イオン書込みヘッド1bの解像度は8ドット/mm程度とされている。また、前記開口13は、前述した図22の(a)に示すヘッド1aの開口3と同様に鋸歯状に配列されている。

【0009】

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【発明が解決しようとする課題】しかしながら、前述した従来のイオン書込みヘッド1（符号は従来のイオン書込みヘッド1a、1bを総称する）においては、潜像形成に必要な量だけのイオン8をリアルタイムにて発生させることが不可能なため、常時多量のイオン8を発生させ、その一部をスクリーン電極2あるいは二枚の制御電極14、14等により潜像担持体7上に導いて静電潜像を形成するようにされている。このため、発生させたイオン8の利用効率が低く、イオン8と同時に発生するオゾンの処理や、消費電力の増大、ヘッド1の大型化、高電圧を制御する制御電極用の駆動回路15の大型化や高価格化等という種々の問題点があった。

【0010】また、従来のイオン書込みヘッド1においては、イオン8が通過する開口3、13の大きさの下限に制約があるという問題点があった。この制約の一つは発生したイオン8の利用効率を大きくするためであり、もう一つは高電圧を印加するスクリーン電極2または制御電極14の加工精度と絶縁耐圧を保持させなければならないということである。

【0011】つまり、大きな開口3、13を有するスクリーン電極2または制御電極14を用いることの問題点は、制御電圧の絶対値が大きくなる点と、イオン書込みヘッド1から潜像担持体7に向かって流れるイオン8（イオン流）を絞った場合に形成される静電潜像の1ドットの直径が十分に小さくならないという点である。イオン流を絞る場合には、電極2、14に加わる電圧のためにイオン流の直径は制御電極2、14の開口3、13の直径の数分の一程度に集束される。このため、形成される静電潜像の1ドットの直径はイオン流を増やした場合に比べて小さくなる。しかし、集束率の限界のためイオン流を絞った場合の静電潜像の電位は中間的な値となり、電位により中間調を再現することになる。

【0012】また、トナーの付着量により濃度階調を再現する場合に、面積階調の場合の再現性は良いが、濃度階調の場合の再現性はトナーの帯電量のばらつき等の要因により再現性があまりよくない。一般に、従来のイオン書込みヘッド1は、他の書込み方式に比べて濃度階調の再現性が優れていると言われている。この再現性について厳密にみると、イオン8の流量が多く面積階調の領域に入る場合の階調の再現性や安定性は優れているが、イオン8の流量を絞った場合の階調再現性は高濃度領域に比べると劣っている。そして、静電潜像の面積は変わらず電位の変化により階調の再現を行なう場合には、静電潜像の形成が入力信号に対して正確に行なわれても現像工程でトナーの付着量のばらつきなどの画像の品位を劣化させる要因が多く、結果的に面積階調における階調再現性よりも劣ったものにならざるを得ない。

【0013】前記開口3、13の大きさを小さくできないことは、解像度を上げられないことと、開口3、13を一直線上に並べられないなどの設計上の制約という問

題点を有している。

【0014】一般に、電子写真方式の印字装置においても、白と黒の二値画像の再現性に対しては一定レベルの印字品質を得ることができるが、中間調を含む画像の再現性は良くない。そこで、現在の電子写真方式においては、ディザを用いた面積階調によって疑似的に中間調を再現する方法が主流になっており、ディザを用いた場合の印字の解像度は、静電潜像形成手段における解像度に比べて大幅に低下する。

【0015】代表的なディザのマトリクスは4×4画素や6×6画素程度で形成される。その場合の階調再現性は16段階および36段階になり、形成される画像の解像度は1/4または1/6となる。階調再現性を重視する場合に、実用的な解像度を得るためには非常に解像度の高い静電潜像を形成する必要がある。

【0016】従来のイオン書込みヘッド1を用いた印字装置においては、中間調の再現性が優れているため、ディザに頼らないでも濃度階調の再現が可能である。そのため開口3、13の大きさの制限等のため解像度を上げられないという問題点を濃度階調の再現性で補うことができると考えられてきた。つまり、写真のような階調再現性が優先される用途においては、解像度は低くても階調再現性が優れていれば再現性を補うことができるが、文字の印字等の高い解像度が要求される用途においては、階調再現性を利用して多少の改善は行なえるとしても、高い解像度を持つ電子写真方式に対して大幅に劣った印字品質しか得られないという問題点があった。

【0017】また、従来のイオン書込みヘッド1においては、複数の開口3、13を印字幅方向に一直線に形成することができず、斜めに複数の開口3、13を並べ、時分割にて一つのラインの静電潜像を形成する方式が用いられており、潜像担持体7に速度のムラがあったり、書込みのタイミングがずれたりすると、静電潜像の位置がずれて印字品質が大幅に低下するという問題点があった。また、画像の並べかえやタイミングの発生等で、図示しない制御回路および駆動回路15などが複雑で高価なものになりやすく、しかも、イオン書込みヘッド1自体が大型化し、イオン書込みヘッド1と潜像担持体7との間の距離を一定に保つことが難しくなるという問題点があった。

【0018】本発明はこれらの点に鑑みてなされたものであり、前述した従来のものにおける問題点を克服し、小型で、イオンの利用効率の高いイオン書込みヘッドを提供することを目的とする。

【0019】

【課題を解決するための手段】前述した目的を達成するため請求項1に記載の本発明のイオン書込みヘッドは、誘電体により構成される潜像担持体上に荷電粒子を選択的に付着させて静電潜像を形成するイオン書込みヘッドであって、基板上に形成された複数の個別電極と、前記



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個別電極上に形成され加熱されることにより荷電粒子を生成するための電子を放出し得る電子放出部と、前記電子放出部を加熱するための加熱部と、前記個別電極と協働して前記電子放出部から放出された電子を加速するためのゲート電極とを有することを特徴としている。

【0020】そして、請求項2に記載の本発明のイオン書込みヘッドは、請求項1において、前記個別電極が前記加熱部を兼用することを特徴としている。

【0021】さらに、請求項3に記載の本発明のイオン書込みヘッドは、請求項1又は請求項2において、前記電子放出部が強誘電体を主体として形成されていることを特徴としている。

【0022】また、請求項4に記載の本発明のイオン書込みヘッドは、請求項1乃至請求項3の何れか1項において、前記加熱部を所定のタイミングで発熱させる駆動回路を有することを特徴としている。

【0023】

【作用】前述した構成からなる本発明のイオン書込みヘッドは、いわゆる熱電子放出の原理を用いてイオンを発生させるものであり、基板上に形成した加熱部を加熱することにより、電子放出部を加熱してそこから熱電子を放出させ、この電子をゲート電極と個別電極との間に印加されている電界により加速してイオンを生成し、このイオンを個別電極と潜像担持体との間に印加されている電界により潜像担持体の表面に移動させて潜像担持体の表面に静電潜像を形成することができる。

【0024】

【実施例】以下、本発明を図面に示す実施例により説明する。

【0025】図1から図3は本発明に係るイオン書込みヘッドの第1実施例を示すものであり、図1は要部の構成を示す縦断面図であり、図2は要部の構成を示す一部切断平面図であり、図3は駆動回路を示す回路図である。

【0026】図1および図2に示すように、本実施例のイオン書込みヘッド16は、基板17上に熱絶縁層18が配設されており、この熱絶縁層18の上面上には、ヒータ層19が配設されている。そして、ヒータ層19の上面上には、中間絶縁層20を介して分解能(画素数)に対応した複数のカソード電極と称される、例えば、直径30 $\mu\text{m}$ 程度の基部77を有する個別電極21が図において左右方向(印字幅方向)に一列状に整列配置されている。さらに、各個別電極21の基部77の上面上には、荷電粒子(イオン)を生成するための電子を放出し得る電子放出部22が配設されている。また、ヒータ層19の上面上には、ヒータ層19の発熱を各電子放出部22に対して集中させるための導電層23が各電子放出部22に対向する部位を除いて配設されている。つまり、本実施例においては、ヒータ層19の各電子放出部22に対応する導電層23に覆われていない部位が、各電子放出

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部22を加熱するための加熱部24とされている。さらにまた、基板17上には、各電子放出部22を中心とした、例えば、直径20 $\mu\text{m}$ 程度の円形の開口25を有するゲート電極26が適宜な厚みの絶縁層27を介して配設され、全体として略平板状に形成されている。

【0027】前記基板17の素材としては、耐熱性が高く、必要な機械強度と加工性を持つものであればよく、アルミナセラミック、ガラス等の絶縁物や表面をSiO<sub>2</sub>等の絶縁物で被覆したシリコン基板等の種々のものを選択することができる。

【0028】前記熱絶縁層18の素材としては、熱伝導率の小さい高融点ガラス、発泡ガラス、ジルコニアセラミック、二酸化ケイ素等の種々のものを選択することができる。

【0029】前記ヒータ層19の素材としては、タングステン、ニクロム、窒化タンタル等の種々のものを選択することができる。

【0030】前記中間絶縁層20の素材としては、大きな電界が加わり発生したイオンに曝されるため、絶縁性能および安定性が高い、SiO<sub>2</sub>、Al<sub>2</sub>O<sub>3</sub>等の無機物の絶縁物を用いることが望ましい。

【0031】前記個別電極21の素材としては、導電性と加工性を考慮し、白金、タングステン、タンタル、モリブデン等の金属素材を用いることが望ましい。

【0032】前記電子放出部22の素材としては、加熱により電子を放出する熱電子放出作用を有する強誘電体、例えば、チタン酸バリウム、チタン酸ストロンチウム、ジルコン酸バリウム、ジルコン酸ストロンチウムなどを例示することができ、これらを必要に応じて単独あるいは組み合わせて用いることができる。

【0033】前記導電層23の素材としては、ヒータ層19より小さな導電率を有し耐熱性に高い白金、タンタル、タングステン、モリブデン等が望ましい。

【0034】前記ゲート電極26の素材としては、モリブデン、タンタル等の種々のものを選択することができる。

【0035】前記絶縁層27の素材としては、大きな電界が加わり発生したイオンに曝されるとともに熱が加わるので、熱損失が少なく絶縁性能および安定性が高い、透明あるいは白色のSiO<sub>2</sub>、Al<sub>2</sub>O<sub>3</sub>等の無機物の絶縁物を用いることが望ましい。

【0036】また、図1に想像線にて示すように、前記イオン書込みヘッド16のゲート電極26に対向するようにして静電潜像が形成される潜像担持体28が配設されるようになっており、この潜像担持体28は、所望の金属基体29の表面に適宜な誘電体層30が形成されるとともに、前記ゲート電極26から100 $\mu\text{m}$ 程度の一定の距離G(ギャップ)を隔てて配設され、前記各電子放出部22が配置されている主走査方向に対して直交する副走査方向に一定速度をもって移動自在にされてい



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る。

【0037】図3に示すように、本実施例のイオン書き込みヘッド16の駆動回路31は、蓄電保持体28のイオン書き込みヘッド16に対して反対側に設けられた金属基体29を背面電極32として接地することにより基準電位が形成されている。この駆動回路31は、ゲート電極26に対してマイナスの極性の電圧を供給する蓄電書き込み用電源VLが電気的に接続されるとともに、ゲート電極26は、各個別電極21に対する共通電極とされている。そして、各個別電極21は、それぞれ適宜な駆動トランジスタ33に接続されるとともに、各駆動トランジスタ33はゲート電極26を基準電位とし、ゲート電極26に対してマイナスの極性の電圧を印加する電子加速用電源VEに電流設定抵抗34を介して接続されている。また、ヒータ層19には、加熱部24の発熱温度を常に一定の温度に制御するための図示しない温度制御部を介して加熱用電源VHが電気的に接続されている。なお、ヒータ層19に対する加熱用電源VHの通電は、制御指令に基づいて、各画素の静電蓄電の形成に同期したパルス電圧により制御することが好ましい。

【0038】前記駆動回路31について更に説明すると、本実施例の駆動回路31は、定電流回路により構成されており、この定電流回路の電流は、各駆動トランジスタ33のエミッタに接続された電流設定抵抗34と、各駆動トランジスタ33のベースに加えられる電圧によって決定される。そして、各駆動トランジスタ33のベース電圧は、抵抗を梯子型に組み合わせたD/A変換回路35を介して重み付けされたデジタル信号を入力することにより印加される。さらに、イオン書き込みヘッド16に対する入力信号は、各々が別の重みを持つシリアル信号36とされ、各々のシリアル信号36に対応するシフトレジスタ37によりパラレル信号に変換される。また、このパラレル信号は、一旦ラッチ38に保持された後、ラッチ信号39により、ゲート回路40に出力され、ゲート回路40によりストローブ信号41とのアンドを取りD/A変換回路35に入力される。このストローブ信号41は、個別電極21のゲート電極26に対する動作時間を決定する信号である。

【0039】すなわち、本実施例における各個別電極21は、個々に絶縁されて定電流特性を有する駆動回路に電気的に接続されており、ヒータ層19は、各加熱部24を直列に接続している。

【0040】なお、ヒータ層19を分割して複数のグループにする構成とすることにより電力を削減することができる。

【0041】つぎに、本実施例のイオン書き込みヘッド1の製造工程について、図4の(a)から(j)により説明する。

【0042】まず、ガラス等の絶縁物からなる略平板状の適宜な基板17の上面に、二酸化ケイ素からなる熱絶

縁層18と、窒化タンタルからなるヒータ層19と、タンタルからなる導電層23とを公知の薄膜形成方法を用いて順次成膜する。そして、ヒータ層19および導電層23の所定の位置をエッチング等により同一形状に除去して、図4の(a)および(b)に示すように、ヒータ層19および導電層23を所定の形状に形成する。ついで、導電層23の所定の位置をエッチング等により除去して、図4の(c)および(d)に示すように、ヒータ層19の所定の部位を露出させ、画素数に対応した所定の数の加熱部24を形成する。つぎに、SiO<sub>2</sub>からなる中間絶縁層25を公知の薄膜形成方法を用いて同様に成膜した後に、図4の(e)および(f)に示すように、タンタル等の金属からなる個別電極21を公知の薄膜形成方法およびエッチングを用いて画素数に対応した所定の数だけ形成する。つぎに、SiO<sub>2</sub>からなる絶縁層27と、タンタル等の金属からなるゲート電極26とを順次同様に成膜した後、図4の(g)および(h)に示すように、ゲート電極26の所定の位置をエッチング等により除去して、所望の大きさの開口25を形成する。ついで、絶縁層27の所定の位置をエッチング等により除去して、図4の(i)に示すように、開口25の下方に位置する個別電極21を露出させる。つぎに、個別電極21上に強誘電体を含有する電着液を泳動電着させて電着膜を成膜することにより電子放出部22を形成し、イオン書き込みヘッドの製造が完成する。なお、電子放出部22を形成する場合には、電子放出部22を形成する前工程にてゲート電極26上にフォトリソ等により適宜な離型層(図示せず)を形成しておき、電子放出部22を形成した後に離型層を除去するとよい。

【0043】つぎに、本実施例のイオン書き込みヘッド16の電子放出部22の形成について更に詳しく説明する。

【0044】本実施例の電子放出部22を形成するには、まず、強誘電体を主成分とする電着液を形成する。この電着液は、チタン酸バリウム等のペロブスカイト型の強誘電体粉末を湿式粉碎によって粒径1μm以下程度に粉碎し、純水にて洗浄して水酸化バリウム等の不純物を除去する。つぎに、メタノールに電解質としての純水1% (wt%)、塩化カルシウム0.0012% (wt%)を加えて電解液を形成する。つぎに、前記電解液に強誘電体化合物の粉末を0.15%加えることにより電着液を形成する。この電着液のPHは7弱、導電率は30μS/cm程度である。このとき、強誘電体化合物自体は、化学的に安定で水への溶解度が小さいが、未反応のバリウムおよびチタン等の酸化物は水と反応して水酸化物となって水に溶解し、電着液の抵抗率を低下させるため予め取り除く必要がある。また、電解液中の塩化カルシウムは、電着液中でカルシウムイオンと塩素イオンとに電離し、形成される電着膜中に水酸化カルシウムと

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して取り込まれる。ついで、電着液を攪拌した後、数時間静置することにより、粒径の大きい強誘電体化合物を沈降させて除去し、電着液の製造が完了する。

【0045】つぎに、イオン書込みヘッド16の個別電極21を陰極とし、陽極にイオン化しにくい白金を用いて50V程度の電圧を加えて泳動電着を行うことにより、各個別電極21上に電着膜が成膜される。この泳動電着時の電流密度は70mA/cm<sup>2</sup>程度、電着速度は1μm/min程度とするとよい。

【0046】つぎに、大気中において200〜300℃程度で数時間加熱する熱処理を施してメタノールを除去しその後600℃程度の温度で大気中あるいは真空中にて数時間加熱することにより、各個別電極21上に電子放出部22が形成される。なお、電着膜中に取り込まれた水酸化カルシウムは、熱処理によって一部が大気中の二酸化炭素と反応して炭酸カルシウムとなり、残りは酸化カルシウムとなり、これらのカルシウム化合物は、強誘電体（強誘電体化合物）の粉体の間を固めるセメントの役目をし、各個別電極21上に形成された電子放出部22となる電着膜を強固なものとする。

【0047】つぎに、本実施例のイオン書込みヘッド16を真空槽に入れ、電子放出部22を加熱して電子放出量（エミッション）を評価した。加熱温度を徐々に高くし、エミッションが微小電流領域から増加する過程を記録した。各々の温度に対するエミッションは、一般的なバリウムやカルシウムの酸化物被覆型の熱電子放出素材と同様のレベルであり、仕事関数がほぼ等しいことが確認できた。また、その温度で数時間動作させた場合に、特性が安定していることが確認できた。

【0048】ついで、真空槽の圧力を真空状態から大気圧状態に向かって徐々に高くし、最終的に大気圧中での特性を評価したところ、個別電極21とゲート電極26との間の電界を大きくすることにより、電子放出部22から電子を効率的に放出できることが判明した。そして、電子放出部22から取り出せる電流は、個別電極21とゲート電極26との間の電界に比例し、その間の距離に反比例する関係にあるとともに、大気中において取り出せる電流は、真空中における場合に比較して1/100から1/1000程度であることが判明した。

【0049】つぎに、前述したイオン書込みヘッド16の作用について説明する。

【0050】本実施例のイオン書込みヘッド16を駆動させ、ヒータ層19に加熱用電源VHの電流を通電すると、ヒータ層19に形成された加熱部24が発熱し、この加熱部24の発熱は、個別電極21および電子放出部22を所定温度に加熱する。そして、加熱された電子放出部22は、熱電子放出の原理によって電子（熱電子）を電子放出部22の外側の空間に放出する。

【0051】前記電子放出部22の外側の空間へ放出された電子は、個別電極21とゲート電極26との間に印

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加された電子加速用電源VEの電圧により形成される電界によって加速された後、ゲート電極26と潜像担持体28との間の空間で酸素分子に捕獲され、酸素イオンとなり荷電粒子としてのマイナスの極性のイオン（図示せず）が生成される。このイオンは、ゲート電極26と潜像担持体28の背面電極32との間に印加されたる潜像書込み用電源VLの電圧により形成される電界によって潜像担持体28の表面に向かって移動する。

【0052】また、本実施例のイオン書込みヘッド16は、従来からある薄膜形成方法およびエッチング等を用いて各個別電極21を一列状に形成し、その上方に電子放出部22を電着させることにより形成されており、複雑で微細な構造の各個別電極21および電子放出部22を容易に形成することができるとともに、ライン状に形成することができ、イオン書込みヘッド16の解像度を容易に向上させることができる。

【0053】つぎに、イオンの生成およびイオンの移動について説明する。

【0054】本実施例においては、ゲート電極26と潜像担持体28との間のギャップGが100μmとされ、ゲート電極26の電位は潜像担持体28の背面電極32に対して-500〜-600Vとされており、ゲート電極26と潜像担持体28との間の電界は5〜6KV/mmにされている。この電界の値は、ゲート電極26と潜像担持体28との間のギャップGにおける大気中の火花放電電圧の半分程度の値である。

【0055】また、電子放出部22を加熱することにより電子を大気中に放出させた場合に、大気圧の空気中での電子の平均自由行程は約400nm、大気中の酸素分子の平均自由行程は64nmであり、放出された電子は100μmのギャップGの間をドリフトする間に、10<sup>1</sup>〜10<sup>4</sup>回大気中の気体分子と衝突し、酸素分子や水蒸気分子に随機的に捕獲されて荷電粒子としてのマイナスの極性のイオン（O<sub>2</sub><sup>-</sup>イオン）が生成される。このとき、酸素分子に低エネルギーの電子が捕獲される確率は、2×10<sup>-4</sup>程度で、潜像担持体28の表面には、イオンと電子とが混ざりあった状態でイオン流となって到達して潜像担持体28の表面にマイナスの極性の電荷を与え、潜像担持体28の表面にマイナスの極性の微細な静電潜像が形成される。つまり、初期状態（静電潜像が書き込まれる前）の潜像担持体28の表面電位は除電によって0Vとされており、潜像担持体28の表面に到達したマイナスの極性のイオンから電子を受け取り、その表面にマイナスの極性のイオンの到達量に比例した電位の静電潜像が形成される。このとき、潜像担持体28の表面に到達するイオンおよび電子は、電気力線に平行に移動するので、静電潜像電位が飽和するまではその広がりを見捨てることのできる。この静電潜像の電位の最大値は、潜像書込み用電源VLの電圧に近い値で飽和する。



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【0056】したがって、静電潜像の電位が飽和した後、潜像担持体28の表面に到達したマイナスの極性のイオンは、潜像担持体28の表面に沿って潜像電位の小さい方に移動し、その部分の表面に電荷を与える。すなわち、潜像担持体28上の静電潜像は同心円状に広がることとなる。この静電潜像の広がり、ゲート電極26と潜像担持体28との間のギャップGが短いほど少なくなる。

【0057】前記イオンの質量は、電子の $5.9 \times 10^{-4}$ 倍程度であり、前記ゲート電極26と潜像担持体28の背面電極32との間の電界によるイオンの移動速度は $100 \text{ m/S}$ 程度とされ、 $100 \mu\text{m}$ の前記ギャップG間のイオンの移動時間は $1 \mu\text{S}$ 程度となる。

【0058】ここで、画像形成の解像度を $300 \text{ DPI}$ 、潜像担持体28の移動速度（プロセス速度）を $100 \text{ mm/S}$ とすると、一つの画素（ドット）の大きさは約 $84.67 \mu\text{m}$ 角で、1ラインの書き込みに要する時間は $847 \mu\text{S}$ となり、イオンの移動速度は、1ラインの書き込み時間より十分に短いので、静電潜像の書き込みの障害にはならない。

【0059】また、電子放出部22からのエミッションが少ない場合には、ゲート電極26の電圧は電子放出部22の電位に対してマイナスとなり、電子放出部22の周囲の空間の開口25に近い部分の電位がマイナスとなって、イオンおよび電子からなるイオン流は、ゲート電極26の開口25の中心部に収束する。このゲート電極26の開口25に対するイオン流の収束率は、最大で3倍程度になる。

【0060】つまり、潜像担持体28上に形成される静電潜像の大きさは、潜像担持体28の表面に到達するマイナスの極性のイオンの量が少ない場合には、電気力線が到達する小さい直径に集中し、到達するイオンの量が増えるにともない静電潜像のマイナスの極性の電位が上昇し、潜像担持体28の表面に到達する電気力線が広がる。それに連れて到達するマイナスの極性のイオンが潜像担持体28の表面上に同心円状に広がり静電潜像の面積が拡大することとなる。

【0061】したがって、発生するイオンの量に対する静電潜像の面積の直線性を極めて高くすることができる。

【0062】すなわち、静電潜像をトナーにより現像してトナー像とする場合において、トナーの付着量の直線性は、静電潜像の電位が中間調を持つ場合と一定電位の静電潜像の面積が変化する場合とでは、面積階調の方が低い印字濃度領域においても微細な面積の静電潜像を形成することができ、広範囲の面積階調による印字が可能になるので、本実施例のイオン書き込みヘッド16は、従来のイオン書き込みヘッド1、1aに比べて階調の再現性が極めて優れた高品位の印字品質を得ることができる。

この印字品質は、文字の印字等の高い解像度が要求され

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る用途に用いられている高い解像度を有する電子写真方式の印字品質に対しても優れている。

【0063】前記静電潜像の面積の拡大は無制限に起きるわけではなく、ゲート電極26と潜像担持体28の背面電極32との間に印加された電界によって到達するイオンの量に応じた一定の範囲に制限される。また、形成される静電潜像の電位も、ゲート電極26と潜像担持体28の背面電極32との間に印加される電圧に近いほぼ一定の値に制限される。

10 【0064】前記ゲート電極26と潜像担持体28との間のギャップGは、トナーの侵入によるショートの可能性や、潜像担持体28を走行させた場合のゲート電極26と潜像担持体28との間のギャップGの精度により制限されるが、ゲート電極26と潜像担持体28との間のギャップGは、略一定の距離Gを常に保持するように構成することが好ましい。

20 【0065】なお、大気中に存在するプラスの極性のイオンは、ゲート電極26と潜像担持体28との間の電界により、イオン書き込みヘッド16の表面に形成され面積が大きく電位が最もマイナスとなるゲート電極26の表面に衝突するので、電子放出部22をスパッタし消耗させる確率は極めて小さく、電子放出部22は、長期間に亘り安定した機能を保持することができる。

【0066】また、イオンが移動する速度は電界の大きさに比例するため、絶縁破壊しない範囲内で高い電界とすることが好ましい。

【0067】つぎに、静電潜像形成に必要な電流について説明する。

30 【0068】前記潜像担持体28の表面に形成される静電潜像の電位は、潜像担持体28に到達するイオンまたは電子の電荷と潜像担持体28の誘電体層30の静電容量の比率で決まる。ここで、潜像担持体28の誘電体層30の膜厚を $20 \mu\text{m}$ 、その誘電率を2.5とすると、 $1 \text{ cm}^2$ 当たりの静電容量は $110.7 \text{ pF}$ となる。この潜像担持体28の誘電体層30を $0 \text{ V}$ から $-500 \text{ V}$ まで帯電させるのに要する電荷は $55.35 \text{ nC}$ である。潜像担持体28の画像記録の幅を $210 \text{ mm}$ 、プロセス速度を $100 \text{ mm/s}$ とすると、イオン書き込みヘッド16全体に必要な電流は $11.62 \mu\text{A}$ である。印字部の長さを $210 \text{ mm}$ とした場合の画素数は、 $300 \text{ DPI}$ で $2480$ 個、 $400 \text{ DPI}$ で $3307$ 個となり、各個別電極21当たりの平均電流は $300 \text{ DPI}$ で $4.69 \text{ nA}$ 、 $400 \text{ DPI}$ で $3.51 \text{ nA}$ となる。

40 【0069】前記個別電極21の大きさを直径 $30 \mu\text{m}$ とすると、その面積は $7.07 \times 10^{-6} \text{ cm}^2$ で、電流密度は、 $300 \text{ DPI}$ で $663 \mu\text{A/cm}^2$ 、 $400 \text{ DPI}$ で $497 \mu\text{A/cm}^2$ となる。そして、電流密度の点では、個別電極21を真空中で動作させる場合の $100 \text{ mA/cm}^2$ よりもかなり小さいが、イオンまたは電子が大気中で散乱されて移動度が低下することを考慮に



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いれると同等のレベルである。この個別電極21の大きさは、電流密度と、加工技術による寸法精度によって制限される。

【0070】つぎに、液体现象を用いた場合の階調再現性について説明する。

【0071】液体现象を用いた場合の階調再現性は、イオン書込みヘッド16の解像度が決定要因となる。本実施例におけるイオン書込みヘッド16は、個別電極21の直径が30 $\mu$ m、ゲート電極26の直径が20 $\mu$ mとされており、静電潜像の大きさの下限は7 $\mu$ mとなり、静電潜像の大きさの上限は、300DPIで84.67 $\mu$ m角、400DPIで63.5 $\mu$ m角となる。そして、静電潜像の直径が7 $\mu$ mの場合のドット面積は38.5 $\mu$ m<sup>2</sup>となり、各々の解像度の1画素の面積は、300DPIで7069 $\mu$ m<sup>2</sup>、400DPIで4032 $\mu$ m<sup>2</sup>となり、面積比は、300DPIで183.6倍、400DPIで104.7倍となり、ディザ無しで概略128階調(7ビット)程度とすることができる。さらに、2~4画素単位のディザにより各色256階調(8ビット)167万色の表示が可能である。

【0072】つぎに、乾式現象を用いた場合の階調再現性について説明する。

【0073】乾式現象を用いた場合の階調再現性は、トナーの粒径が決定要因となる。現在の粉砕法による高画像度トナーの代表的な粒径は、7 $\mu$ m程度であり、静電潜像の大きさの下限は14 $\mu$ m程度とされている。この場合のドット面積は153.9 $\mu$ m<sup>2</sup>で、静電潜像の面積比は、300DPIで45.9倍、400DPIで26.2倍となり、静電潜像の大きさの直線性が高いため、各画素の印字濃度が上記の面積比で決定される最低値より大きい場合には、ディザの処理は不要となる。また、印字濃度が上記の面積比の最低値より小さい場合には、各色8ビットの階調再現を得るためには、3×3の9ドットや、4×4の16ドット単位のマトリクスのディザを用いるとよい。

【0074】つぎに、イオン書込みにおける解像度について説明する。

【0075】本実施例のイオン書込みヘッド16を用いた印字装置によれば、三原色に各々8ビット(256階調)合計167万色が殆どディザを用いずに再現でき、画像の解像度は写真や昇字型に近いレベルとすることができる。

【0076】カラーのビットマップの画像の場合、情報量の制限のために大部分のデータの画素はイオン書込みヘッド16によって構成される画像の画素数よりも少なく、ソフトウェアにより拡大して印字することになる。代表的な画素数として横640ドット、縦480ドット、24ビット(167万色)の情報量はデータを圧縮しない場合900kバイトとなる。その画像を横8cm、縦6cmの大きさで印字する場合の解像度は8ドッ

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ト/mm(約200DPI)となる。解像度が通常のページプリンタと同じ300~400DPIあれば、特別に解像度が高い画像の印字を行なう場合以外は忠実な再現性を得ることが可能である。

【0077】また、本実施例のイオン書込みヘッド16を用いた印字装置によれば、濃度階調の再現性において電子写真方式等に対し圧倒的に優れているが、階調のない文字の印字においては印字ヘッドの解像度が画質を決定する要因となる。印字ヘッドとしてのラインヘッドの画素が並ぶ方向(主走査方向)の解像度は、印字ヘッドの解像度により決まるが、本実施例のイオン書込みヘッド16における画素の数となる個別電極21の数は、潜像担持体28または印字媒体が移動する方向(副走査方向)に対して細分化(増加)させることが容易であり、文字の印字の場合、イオン書込みヘッド16における個別電極21の数を増加させ解像度を高くすることにより、印字した文字の縁のぎざぎざを円滑にすることができる。

【0078】したがって、高電圧を用いたコロナ放電や高周波放電による従来のイオン書込みヘッド1、1aと異なり、本実施例のイオン書込みヘッド16は、静電潜像形成に必要な量だけのイオンをリアルタイムに発生させることができるとともに、駆動回路31の集積化が容易になり、確実に小型化、低価格化することができる。とともに、解像度を確実に向上させることができる。

【0079】図5から図8は本発明に係るイオン書込みヘッドの第2実施例を示すものであり、図5は要部の構成を示す縦断面図であり、図6はゲート電極と絶縁層を省いた平面図であり、図7は図6の側断面図であり、図8は駆動回路を示す回路図である。

【0080】本実施例のイオン書込みヘッド16aは、前記第1実施例の個別電極21がヒータ層19の機能を兼ねるとともに、個別電極21をグループ化した構成としたものである。

【0081】図5に示すように、本実施例のイオン書込みヘッド16aは、基板17上に熱絶縁層18が配設されており、この熱絶縁層18の上面には、前述した第1実施例のヒータ層19および個別電極21を兼用するための所定の形状の加熱個別電極層42が配設されている。そして、加熱個別電極層42の上面には、導電層23が配設されている。さらに、加熱個別電極層42および導電層23は、同一の所定の形状にエッチングされている。また、加熱個別電極層42上の導電層23の所定の位置はエッチング等により除去されており、これにより、加熱個別電極層42の発熱を電子放出部22に対して集中させる加熱部24と、分解能(画素数)に対応したカソード電極と称される個別電極21aとが形成されている。この個別電極21aは、例えば、直径30 $\mu$ m程度の大きさとされ、図5および図6に示すように左右方向(印字幅方向)に一列状に整列配置されている。そ

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して、各個別電極21aの上面には、荷電粒子（イオン）を生成するための電子を放出し得る電子放出部22が配設されている。また、熱絶縁層18上には、各電子放出部22を中心とした、例えば、直径20 $\mu$ m程度の円形の開口25を有するゲート電極26が適宜な厚みの絶縁層27を介して配設され、全体として略平板状に形成されている。

【0082】前記加熱個別電極層42の素材としては、白金、タンタル、モリブデン、タンゲステン等が適している。

【0083】すなわち、本実施例のイオン言込みヘッド16aにおいては、加熱個別電極層42の導電層23に覆われていない部位が、個別電極21aとされとともに各電子放出部22を加熱するための加熱部24aとされ、個別電極21a上に電子放出部22が直接形成される構成になっている。また、図6に示すように、本実施例における加熱個別電極層42は、4個の個別電極21aが1組となるようにグループ化されている。この1グループ中の個別電極21aの数は、イオン言込みヘッド16aの分解能や設計コンセプト等により決定すればよく、特に、本実施例の個別電極21aの数に限定されるものではない。

【0084】図8に示すように、本実施例のイオン言込みヘッド16aの駆動回路31aは、各個別電極21aを時分割して加熱するように構成されており、加熱用電源VHが絶縁型のDC/DC変換回路43および各個別電極21a毎の継断用のスイッチとしてのヒータ切換回路44を介して各個別電極21aに接続されている。そして、ヒータ切換回路44には、各個別電極21aに対応するフォトカプラ45を介してヒータ切換回路44を継断するヒータ切換信号46が入力されるようになっている。その他の構成は、前述した第1実施例の駆動回路31と同様である。

【0085】このような構成とすることにより本実施例は、前述した第1実施例と同様の効果を奏するとともに、加熱部24を兼ねた個別電極21a上に電子放出部22を直接形成する構成とすることにより、製造工程が簡略化され製造工程の数を削減し、経済的負担を確実に低減することができる。また、小型化を図り、熱容量を（蓄熱量）を小さくすることができるので、温度変化に対する応答性を向上させ、電子放出部22が電子を放出するための加熱時間を短くすることができる。また、第1実施例における中間絶縁層20を省くことができるので、温度勾配がなく、熱の利用効率を確実に向上させることができる。

【0086】図9から図13は本発明に係るイオン言込みヘッドの第3実施例を示すものであり、図9は要部の構成を示す縦断面図であり、図10は図9の平面図であり、図11はゲート電極と絶縁層を省いた要部の構成を示す平面図であり、図12は図11の側断面図であり、

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図13は駆動回路を示す回路図である。

【0087】本実施例のイオン言込みヘッド16bは、前記第2実施例の各個別電極21aに対応するようにゲート電極26を分割した構成としたものである。

【0088】図9から図12に示すように、本実施例のイオン言込みヘッド16bは、加熱個別電極層42に形成された各個別電極21aに対応するように、絶縁層27により分割されたゲート電極26aが配設されており、加熱個別電極層42の形状もゲート電極26aに対応するように形成されている。その他の構成は、前述した第2実施例のイオン言込みヘッド16aと同様である。

【0089】図13に示すように、本実施例のイオン言込みヘッド16bの駆動回路31bは、各ゲート電極26aを時分割して加熱するとともに、各個別電極21aをグループ毎に加熱するように構成されており、潜像言込み用電源V<sub>L</sub>は、各ゲート電極26a毎の継断用のスイッチとしてのゲート切換回路47を介して各ゲート電極26aに接続されている。このゲート切換回路47は、ゲート切換信号48により動作するようにされている。また、加熱用電源V<sub>H</sub>は、絶縁型のDC/DC変換回路43を介して4個単位でグループ化された個別電極21aに接続されている。その他の構成は、前述した第2実施例の駆動回路31aと同様である。

【0090】このような構成とすることにより本実施例は、前述した第2実施例と同様の効果を奏することができる。

【0091】つぎに、本実施例の各イオン言込みヘッド16A（符号はイオン言込みヘッド16、16a、16bを総称する）のゲート電極26A（符号はゲート電極26、26aを総称する）と潜像担持体28との距離Gを一定に保持する構造について図14から図18により説明する。

【0092】図14はイオン言込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第1実施例を示すものである。

【0093】本実施例は潜像担持体28として表面に誘電体層30を有する誘電体ドラム49を用いたものである。

【0094】本実施例においては、イオン言込みヘッド16Aの印字帽方向である長手方向の両端部に適宜な接触ローラ50、50が配設されており、この接触ローラ50、50を介して誘電体ドラム49が配置されている。そして、各接触ローラ50、50は、誘電体ドラム49の表面の印字領域を避けるようにして回転自在に配設されるとともに、誘電体ドラム49の表面と当接されている。さらに、イオン言込みヘッド16Aは、誘電体ドラム49の表面の法線方向に移動自在に支持されており、イオン言込みヘッド16Aの背面に配設された図示しない支持フレームと当接されている適宜な与圧スプ

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リング51の押圧力をもって誘電体ドラム49の表面に対して所定の距離(間隔)を保持できるようにされている。なお、各接触ローラ50の接触圧を小さくして、誘電体ドラム49の印字領域に接触させてもよい。

【0095】図15はイオン書き込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第2実施例を示すものである。

【0096】本実施例においては、図14に示す第1実施例のようにイオン書き込みヘッド16Aに接触ローラ50は配設されておらず、代わりに、イオン書き込みヘッド16Aの下部に誘電体ドラム49を清掃するクリーニング手段としての所望のブレード52を配設したものである。そして、ブレード52の下方には、適宜な廃トナー受け53が配置されている。また、誘電体ドラム49は図15において下方に示す転写・定着部54にて用紙などの記録媒体55と接するようにされている。

【0097】このような構成によっても、図14に示す前述した第1実施例と同様に、イオン書き込みヘッド16Aのゲート電極27Aと潜像担持体28との距離を一定に保持することができる。

【0098】図16はイオン書き込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第3実施例を示すものであり、(a)は斜視図、(b)は縦断面図である。

【0099】本実施例は、潜像担持体28として可撓性を有する無端ベルト状の誘電体ベルト56を用いたものである。

【0100】本実施例においては、イオン書き込みヘッド16Aに適宜なベルト保持部材57が配設されており、誘電体ベルト56をイオン書き込みヘッド16Aに対して位置決めし、イオン書き込みヘッド16Aの図示しないゲート電極26Aと誘電体ベルト56の表面との距離を一定に保たせるようになっている。この場合には、誘電体ベルト56の厚さを一定とすることが肝要である。

【0101】このような構成によれば、図14および図15に示す誘電体ドラム49を用いる構成と比較して、イオン書き込みヘッド16Aの位置を簡単に固定できるので、イオン書き込みヘッド16Aのゲート電極27Aと潜像担持体28との距離を一定に保持するうえで有利である。

【0102】図17はイオン書き込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第4実施例を示すものである。

【0103】本実施例は図16に示す第3実施例と同様に、潜像担持体28として誘電体ベルト56を用いたものである。

【0104】本実施例においては、誘電体ベルト56の表面をイオン書き込みヘッド16Aの表面を覆うように配設したベルト保持部材57a側に押しつけて距離を一定に保持させたものである。そして、本実施例のベルト保

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持部材57aには、イオン書き込みヘッド16Aの下流側表面58を誘電体ベルト56の表面に形成された静電潜像を乱さないように適宜な絶縁体からなる絶縁層59で形成したものである。なお、イオン書き込みヘッド16Aの下流側表面58を誘電体ベルト56の表面と接触しないようにするとともに、イオン書き込みヘッド16Aの上流側表面60に導電性の材料からなる導電層61を形成し、誘電体ベルト56の除電を行なうようにしてもよい。

【0105】図18はイオン書き込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第5実施例を示すものである。

【0106】本実施例は図17に示す第4実施例の構造に、イオン書き込みヘッド16Aの表面から流体(空気)を誘電体ベルト56に向かって噴射させ、誘電体ベルト56をイオン書き込みヘッド16Aの表面から一定の高さに浮上させるようにしたものである。

【0107】本実施例においては、ヘッド保持部材55aの表面に複数の噴射孔62を設けるとともに、各噴射孔62を流れる空気の流量のバランスを保つための適宜なオリフィス63を各噴射孔62に接続する各流路64に設け、加圧空気を各流路64に対して供給自在としたものである。なお、誘電体ベルト56のイオン書き込みヘッド16Aに対する浮上量は50μm程度とするとよい。

【0108】このような構成によれば、誘電体ベルト56はイオン書き込みヘッド16Aと接触しないため、イオン書き込みヘッド16Aの表面の導電性の有無の影響を受けることがない。また、空気の圧力により誘電体ベルト56の表面に付着する図示しないトナーを外部に排除することができるので、電子放出部にトナーが付着するという不都合を確実に防止することもできる。

【0109】つぎに、本実施例のイオン書き込みヘッド16Aを用いた印字装置について図19から図21により説明する。

【0110】図19は本発明に係る印字装置の第1実施例を示すものである。

【0111】本実施例の印字装置65は、潜像担持体28として誘電体ドラム49を用いたものである。

【0112】図19に示すように、本実施例の印字装置65は、誘電体ドラム49が図19において矢印にて示す時計方向に回転自在に配設されており、この誘電体ドラム49の周囲に、図19において上部から時計方向に、誘電体ドラム49上に図示しない所望の画像に対応した静電潜像を形成する潜像形成手段としてのイオン書き込みヘッド16Aと、静電潜像を図示しないトナーにより顕像化する顕像手段としての適宜な顕像器66と、トナーにより顕像化された静電潜像を用紙などの記録媒体55上に転写するとともに定着する転写定着手段としての加圧ローラ67と、誘電体ドラム49を清掃するク



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リーニング手段としての適宜な金属製のブレード68を有するクリーナ69と、誘電体ドラム49の荷電状態を除去する除電手段としての適宜なAC除電器70とが順に配置されて形成されている。

【0113】前記現像器66には、マイナス帯電の感光体を用いた正規現像と同じプラス帯電のトナー（図示せず）が用いられており、現像器66のスリーブ71には、特にバイアス電圧を加えずに接地電位にて用いられる。

【0114】また、転写および定着は、誘電体ドラム49に加圧ローラ67を所望の当接力をもって当接させて記録媒体55を誘電体ドラム49に押し付け、前記圧接力の圧力により同時に行うようになっている。これにより、熱定着器を用いずに定着が可能となり、消費電力を減少させるとともに、ウォームアップ時間を不要とすることができる。

【0115】また、従来の電子写真に用いられるクリーナのブレード（図示せず）は、感光体（図示せず）が傷つき易いためにゴム製とされているが、本実施例の印字装置65のクリーナ69のブレード68は、誘電体ドラム49の強度が高いため金属製のものを用いることができる。ブレード68の精度、耐久性を確実に向上させることができる。そして、誘電体ドラム49の除電には、AC除電器70によりプラスとマイナスの両極性のイオンを用いて誘電体ドラム49の表面の電荷を効率よく中和することができる。

【0116】このような構成からなる本実施例の印字装置65によれば、前述したイオン言込みヘッド16Aの効果と相まって、階調の再現性が極めて高い高品位の印字品質を得ることができるとともに、多種多様の用途に用いることができる。

【0117】図20は本発明に係るヘッドを用いた印字装置の第2実施例を示すものである。

【0118】本実施例の印字装置65aは、潜像担持体28として誘電体ベルト56を用いたものである。

【0119】図20に示すように、本実施例の印字装置65aにおいては、回転自在に支持されるとともに上下に開閉状態とされた2本のローラ72、73が配置されており、ローラ72、73の何れか一方は駆動ロール、他方は従動ロールとされている。そして、それぞれのローラ72、73の外周面に接触するようにして誘電体ベルト56が巻回されている。さらに、誘電体ベルト56は、前記各ローラ72、73により図20において矢印にて示す方向に走行自在とされている。

【0120】前記誘電体ベルト56の下部左方には、図示しない所望の画像に対応した静電潜像を形成する潜像形成手段としてのイオン言込みヘッド16Aが配置されている。そして、誘電体ベルト56の下部右方には、静電潜像を図示しないトナーにより顕像化する現像手段としての適宜な現像器66が配置されている。さらに、誘

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電体ベルト56の上部左方には、誘電体ベルト56を清掃するクリーニング手段としての適宜なクリーナ69が配置されている。また、イオン言込みヘッド16Aとクリーナ69との間には、誘電体ベルト56と対向するようにして誘電体ベルト56の表面の荷電状態を除去する除電手段としての適宜なAC除電器70が配置されている。

【0121】前記誘電体ベルト56の上部には、図20において矢印にて示す水平方向左方に走行自在とされた記録媒体55を介して、トナーにより顕像化された静電潜像を記録媒体上に転写する静電転写としてのイオン発生器74が配置されている。このイオン発生器74は、イオン言込みヘッド16Aと同様な電子放出部22を有する構造とされている。

【0122】また、記録媒体55の走行方向下流側には、記録媒体55にトナーを熱的作用により定着させる定着手段としての定着ローラ75と、弾性を有する加圧ローラ76とが、記録媒体55を挟持自在にして配置されている。

【0123】このような構成からなる本実施例の印字装置65aによれば、前述した第1実施例の印字装置65と同様な効果を奏する。そして、本実施例の静電転写に用いるイオン発生器74の構造は、画像形成の必要がなく電流の均一性の要求も少ないため、電子放出部22の数を減らしたり、イオン発生器74と誘電体ベルト56との間の距離を大きくしたりすることができる。さらに、記録媒体55に対するトナーの定着を、定着ローラ75と加圧ローラ76とにより行うので、前述した第1実施例の印字装置65の加圧ローラ67を用いた場合の、記録媒体55およびトナーを高い圧力で押しつぶすことによる記録媒体55およびトナーの光沢の発生を確実に防止して、より高品位の印字品質を得ることができる。また、イオン発生器74はイオン言込みヘッド16Aと同様に小型化するとともに低電圧、低消費電力にて動作させることができるとともに、イオン発生器74は、図示しないコトロン等の他のイオンの発生手段と比べて、発生するイオンの密度が高いため転写領域が限定され、転写による画像の劣化を確実に防止することができる。さらに、イオン発生器74はイオン言込みヘッド16Aと同じ極性で、かつ、少ない電流にて動作させることができるので、イオン言込みヘッド16Aの図示しない駆動回路の電源を共用することができる。このことは、印字装置65aの全体の駆動回路および装置（図示せず）等の小型化を確実に図ることができるとともに、経済的負担を確実に減少させることができる。

【0124】図21は潜像担持体として誘電体ベルトを用いた印字装置の他の例を示すものである。

【0125】本実施例の印字装置65bにおいては、前述した第2実施例の印字装置65aのようにトナーにより顕像化された静電潜像を記録媒体55上に転写する静

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電転写としてのイオン発生器 7 4 は配置されておらず、代わりに記録媒体 5 5 にトナーを転写するとともに定着させる転写定着手段として定着ローラ 7 5 と加圧ローラ 7 6 とがポリイミド等の耐熱性の素材により形成された誘電体ベルト 5 6 a を挟持するようにして配置されており、この定着ローラ 7 5 の下方に、2 本のローラ 7 2, 7 3 が左右に平行に配置され、前記誘電体ベルト 5 6 a が前記定着ローラ 7 5 と 2 本のローラ 7 2, 7 3 とのそれぞれの外周面に接触するようにして巻回されている。

【0126】前記誘電体ベルト 5 6 a の下部には、図示しない所望の画像に対応した静電潜像を形成する潜像形成手段としてのイオン書き込みヘッド 1 6 A が配置されており、誘電体ベルト 5 6 a の下部右方には、前記静電潜像を図示しないトナーにより顕像化する現像手段としての適宜な現像器 6 6 が配置されている。さらに、誘電体ベルト 5 6 a の下部左方には、誘電体ベルト 5 6 a を清掃にするクリーニング手段としての適宜なクリーナ 6 9 が配置されており、その上方に誘電体ベルト 5 6 a と対向するようにして誘電体ベルト 5 6 a の荷電状態を除去する除電手段としての適宜な A C 除電器 7 0 が配置されている。

【0127】このような構成からなる本実施例の印字装置 6 5 b によれば、前述した第 2 実施例の印字装置 6 5 a と同様な効果を奏するとともに、転写時の画像の劣力をより確実に防ぎ、より高品位の印字品質を得ることができ、かつ、小型化を容易に図ることができる。なお、定着ローラ 7 5 の代わりにサーマルヘッドのような一次元の発熱素子あるいは二次元の発熱体等を用いることもできる。

【0128】また、本発明は、前記各実施例に限定されるものではなく、前記各イオン書き込みヘッド 1 6, 1 6 a, 1 6 b と、前記個別電極 2 1, 2 1 a と、前記各駆動回路 3 1, 3 1 a, 3 1 b との組み合わせは、設計コンセプトにより決定すればよく、各種の組み合わせのものから選択することができる。

【0129】さらにまた、本発明は、前記各実施例に限定されるものではなく、必要に応じて変更することができる。

【0130】

【発明の効果】このように本発明のイオン書き込みヘッドによれば、熱電子放出の原理によりイオンを発生させるので、低エネルギーでイオンを発生させることができる。また、イオンの発生にコロナ放電を用いないためオゾンが発生がない。また、ゲート電極と個別電極、個別電極と潜像担持体の間にかかる電界を制御するだけで書き込みに寄与するイオン流の大きさを制御することができるので、形成されるトナー像の大きさを多段階に変化させて多階調の印画をたやすく行なうことができる等の極めて優れた効果を奏する。

【図面の簡単な説明】

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【図 1】本発明に係るイオン書き込みヘッドの第 1 実施例の要部の構成を示す縦断面図

【図 2】図 1 の一部切斷平面図

【図 3】本発明に係るイオン書き込みヘッドの第 1 実施例の駆動回路を示す回路図

【図 4】(a) から (j) は本発明に係るイオン書き込みヘッドの第 1 実施例の製造工程を説明する説明図

【図 5】本発明に係るイオン書き込みヘッドの第 2 実施例の要部の構成を示す縦断面図

10 【図 6】本発明に係るイオン書き込みヘッドの第 2 実施例のゲート電極と絶縁層を省いた平面図

【図 7】図 6 の側断面図

【図 8】本発明に係るイオン書き込みヘッドの第 2 実施例の駆動回路を示す回路図

【図 9】本発明に係るイオン書き込みヘッドの第 3 実施例の要部の構成を示す縦断面図

【図 10】本発明に係るイオン書き込みヘッドの第 3 実施例の要部の構成を示す平面図

20 【図 11】本発明に係るイオン書き込みヘッドの第 3 実施例のゲート電極と絶縁層を省いた要部の構成を示す平面図

【図 12】図 12 は図 11 の側断面図

【図 13】本発明に係るイオン書き込みヘッドの第 3 実施例の駆動回路を示す回路図

【図 14】本発明に係るイオン書き込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第 1 実施例を示す要部の斜視図

30 【図 15】本発明に係るイオン書き込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第 2 実施例を示す要部の側面図

【図 16】本発明に係るイオン書き込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第 3 実施例を示すものであり、(a) は斜視図、(b) は縦断面図

【図 17】本発明に係るイオン書き込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第 4 実施例を示す要部の縦断面図

40 【図 18】本発明に係るイオン書き込みヘッドのゲート電極と潜像担持体の距離を一定に保持する構造の第 5 実施例を示す要部の縦断面図

【図 19】本発明に係るイオン書き込みヘッドを用いた印字装置の第 1 実施例の要部の構成を示す構造図

【図 20】本発明に係るイオン書き込みヘッドを用いた印字装置の第 2 実施例の要部の構成を示す構造図

【図 21】本発明に係るイオン書き込みヘッドを用いた印字装置の第 3 実施例の要部の構成を示す構造図

50 【図 22】従来のイオン書き込みヘッドの一例を示すものであり、(a) は全体の形状を示す斜視図、(b) は要部の構成を示す縦断面図、(c) はライン電極とフィンガー電極との配置状態を示す説明図

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【図23】従来のイオン書き込みヘッドの他の例を示す模式図

【符号の説明】

16, 16a, 16b, 16A イオン書き込みヘッド

17 基板

18 熱絶縁層

19 ヒータ層

21, 21a, 個別電極

\* 22 電子放出部

23 導電層

24, 24a 加熱部

25 開口

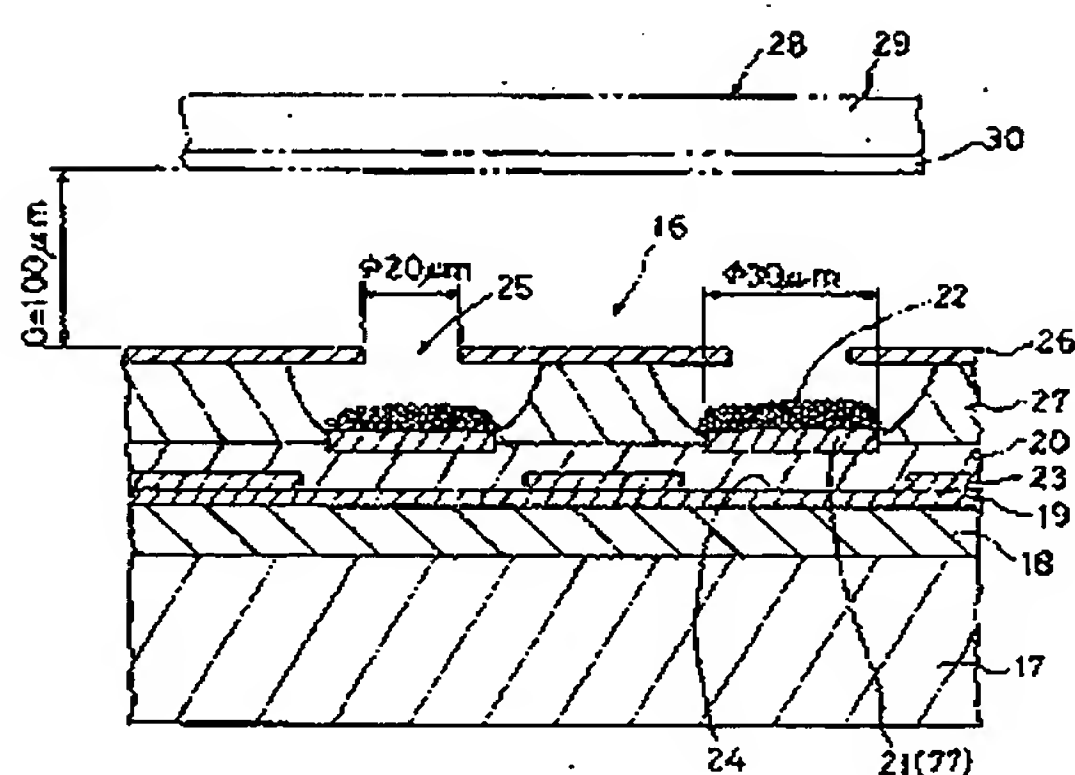
26, 26a, 26A ゲート電極

27 絶縁層

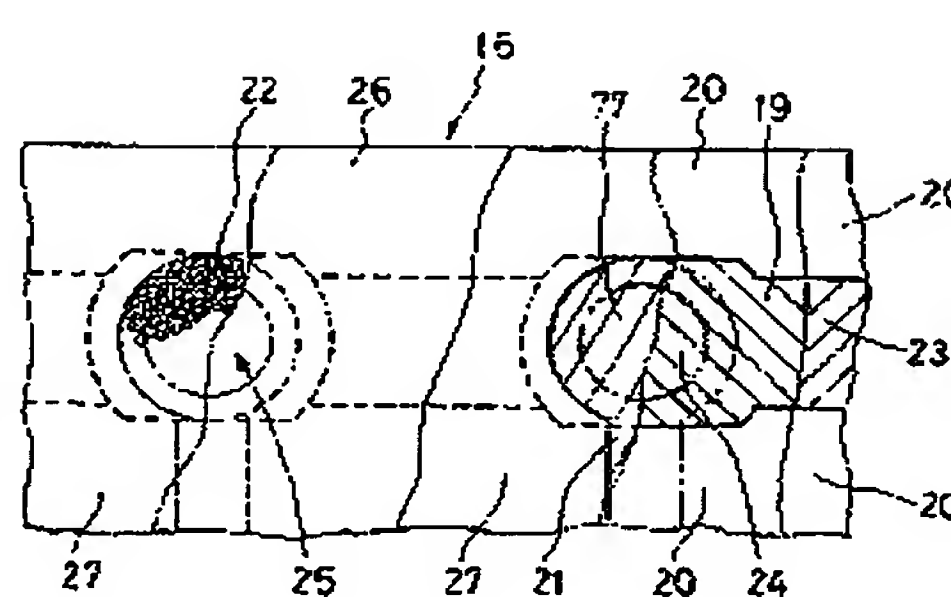
31, 31a, 31b 駆動回路

\* 42 加熱個別電極層

【図1】

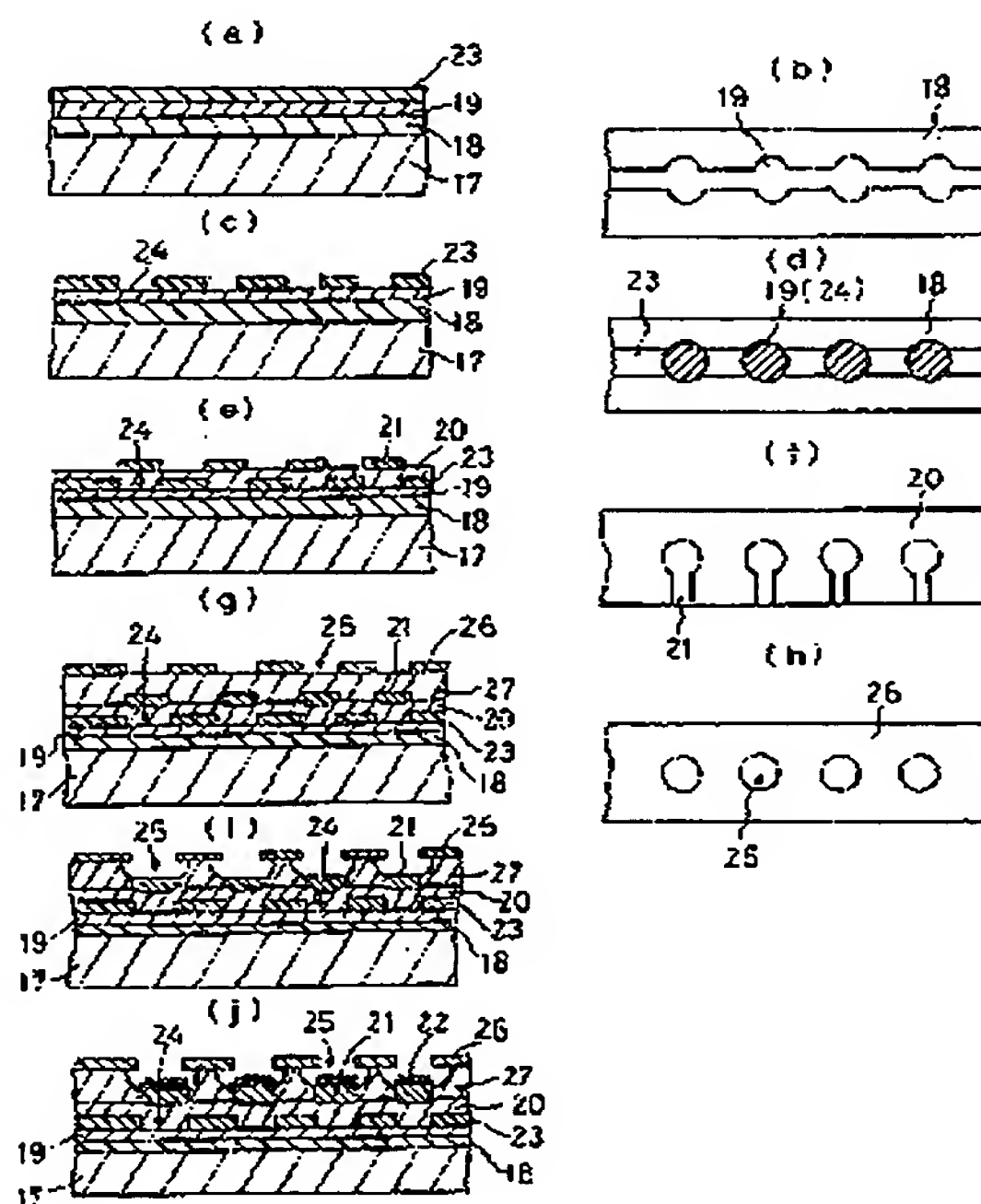
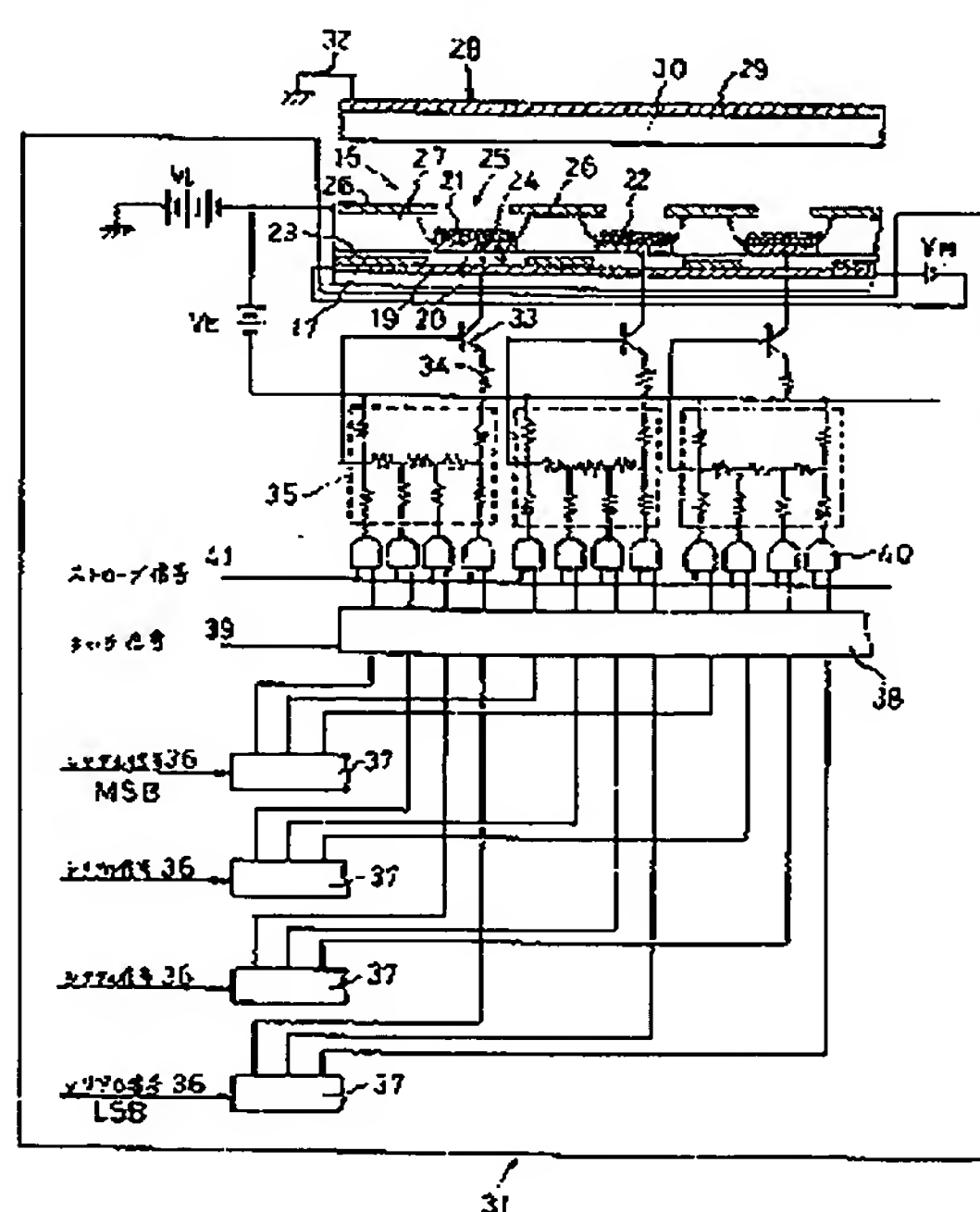


【図2】



【図4】

【図3】



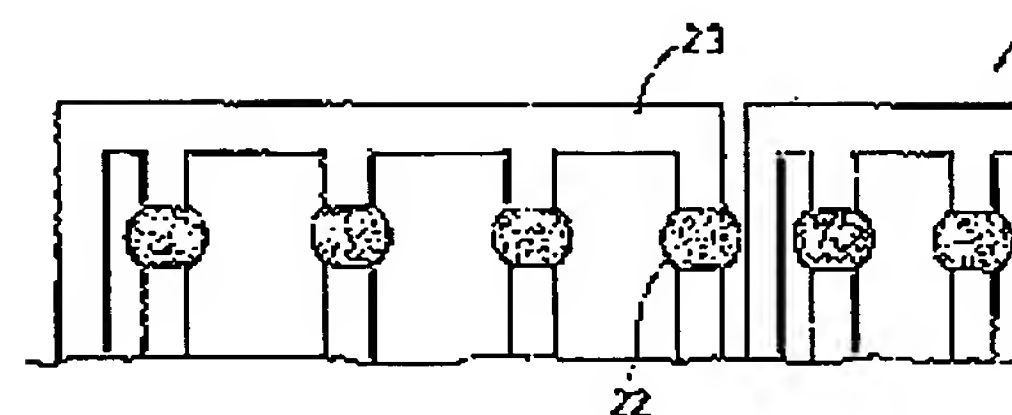
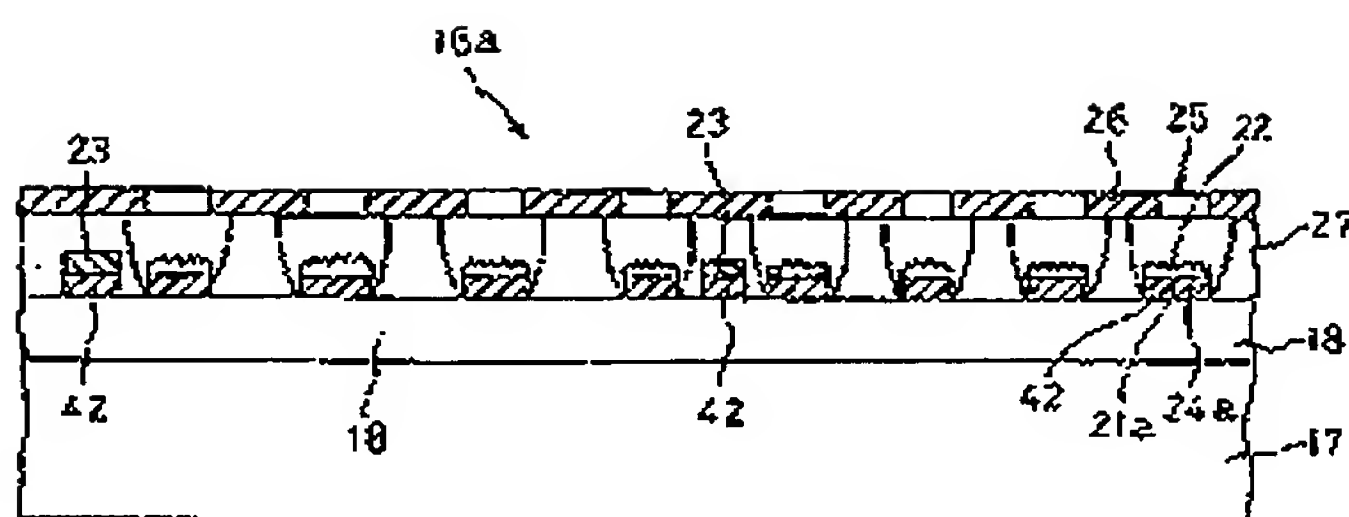


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【図 5】

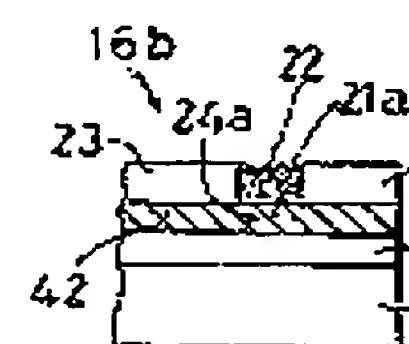
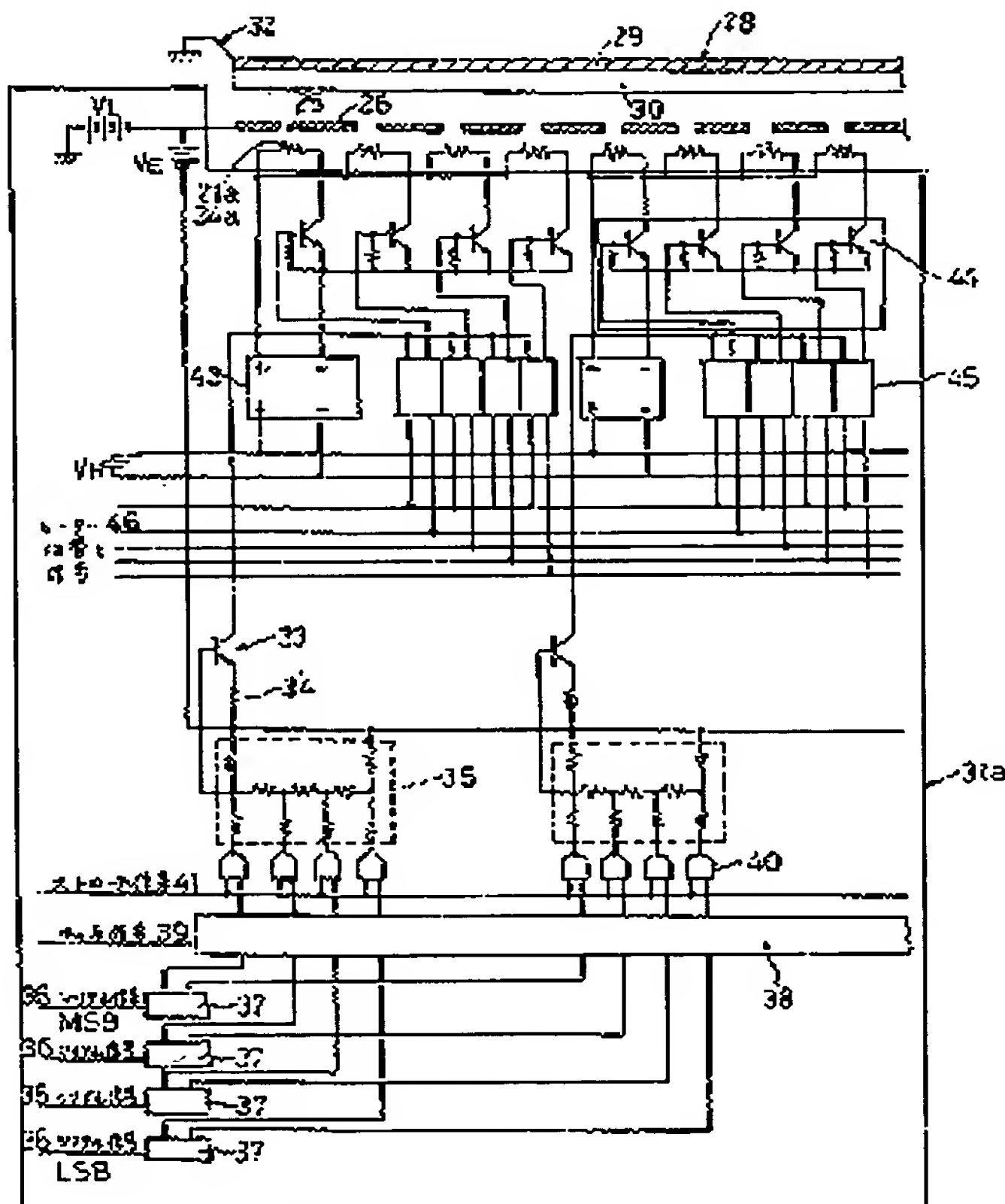
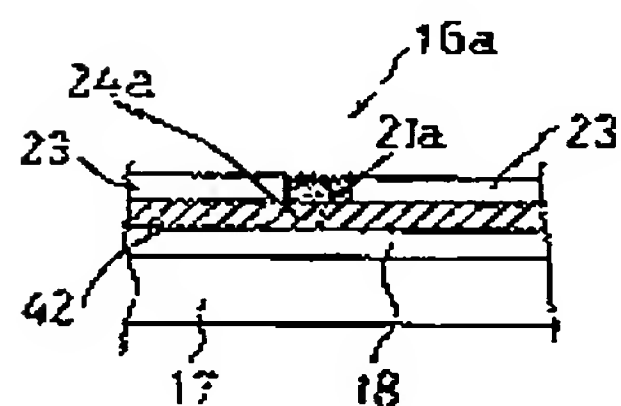
【図 6】



【図 12】

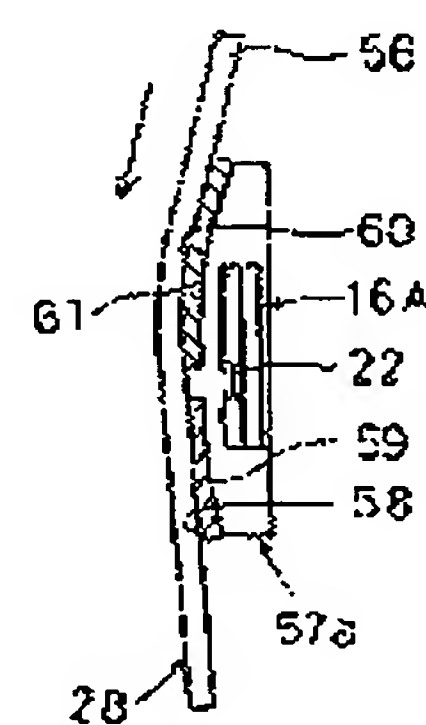
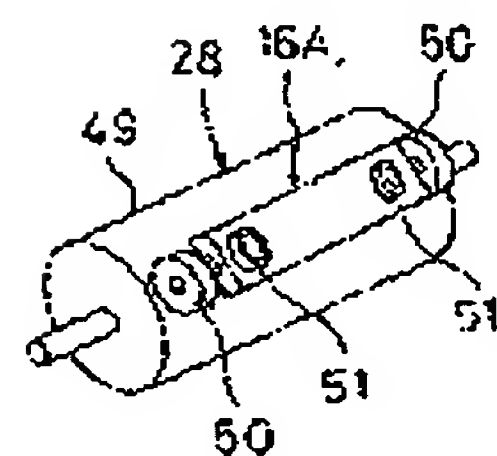
【図 7】

【図 8】



【図 17】

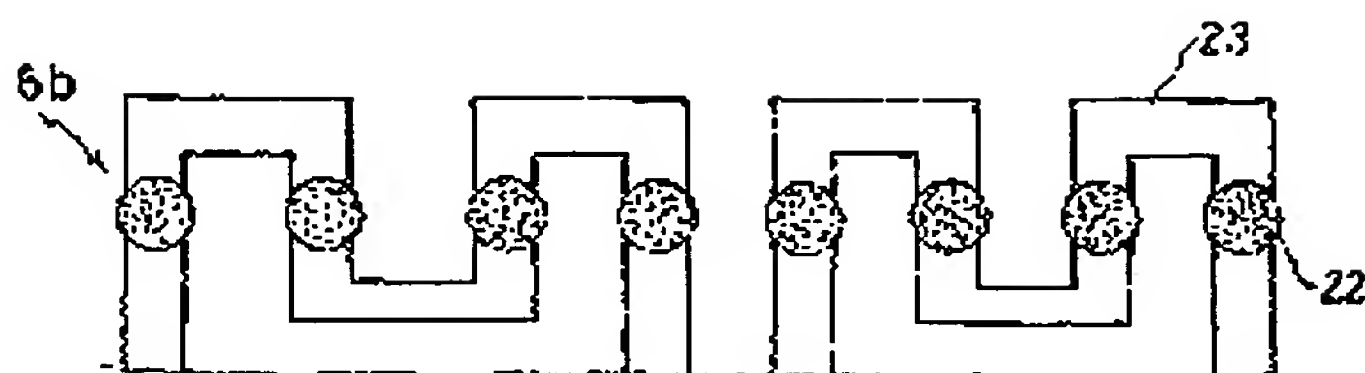
【図 14】



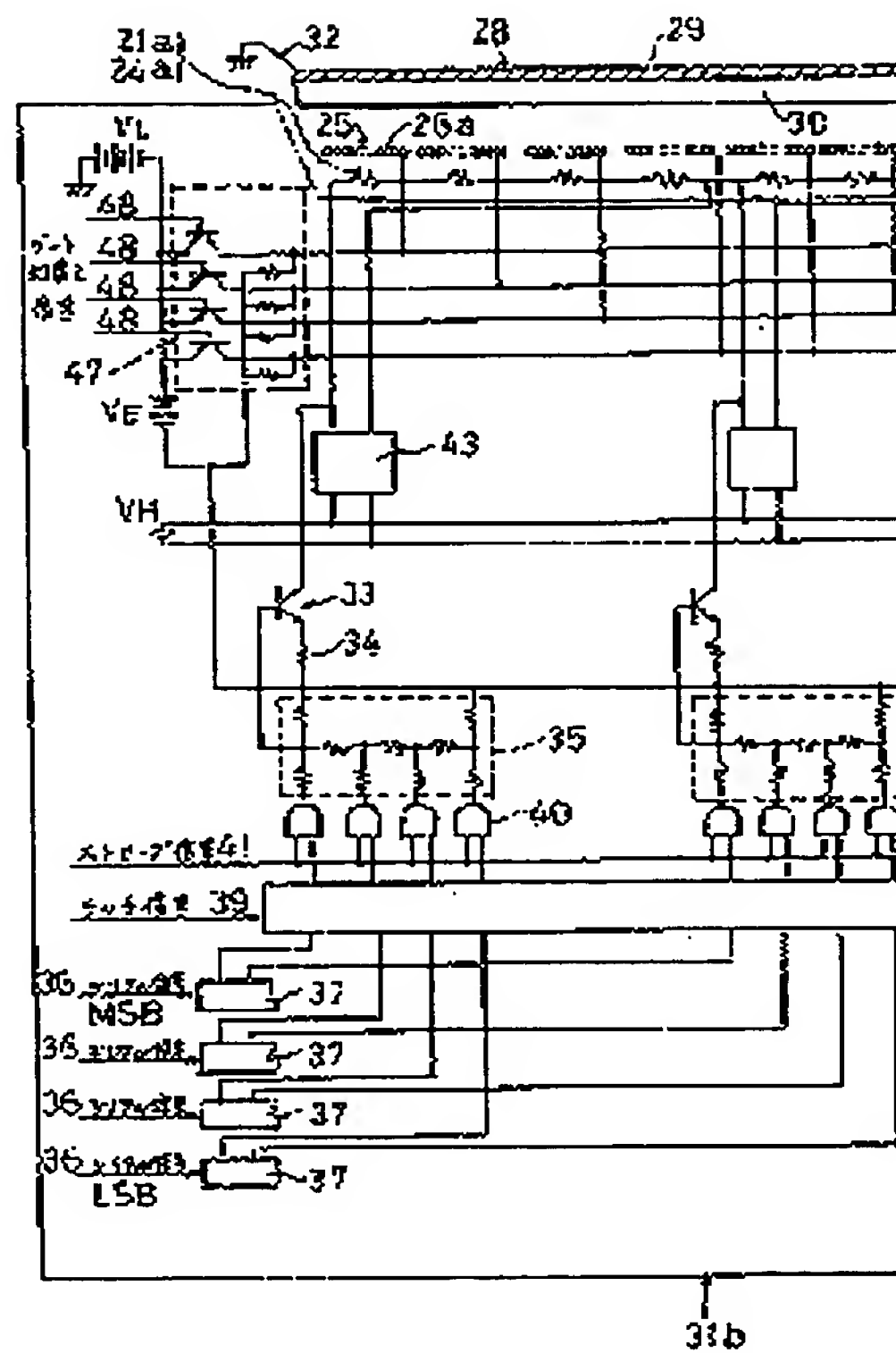
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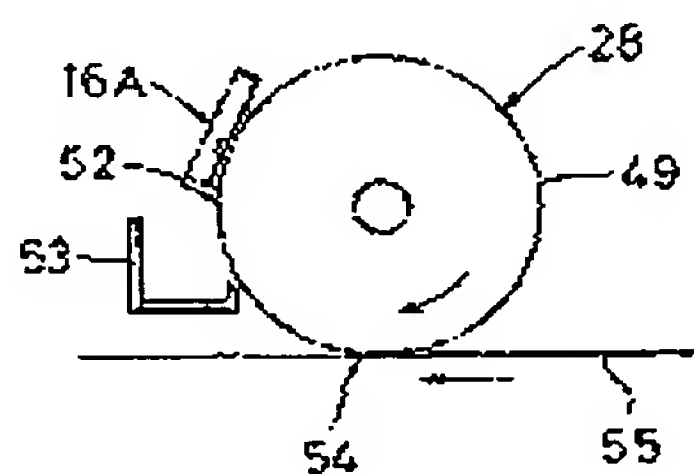
【図 11】



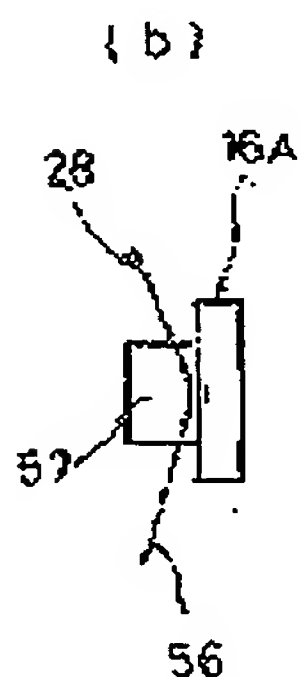
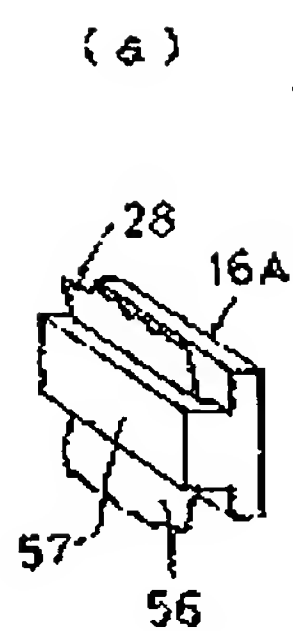
【図 13】



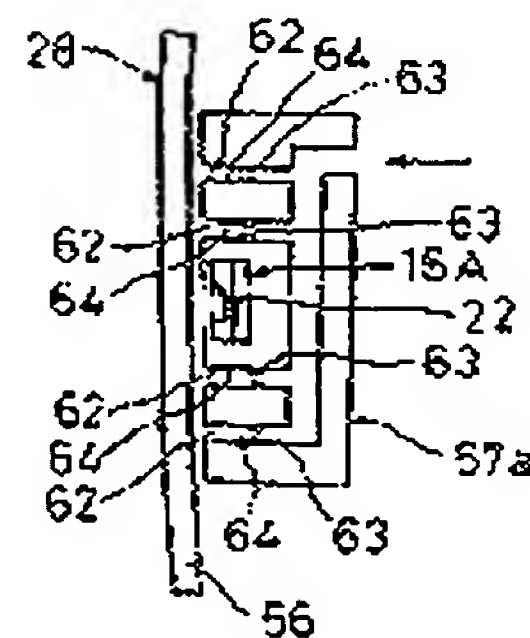
【図 15】



【図 16】



【図 18】



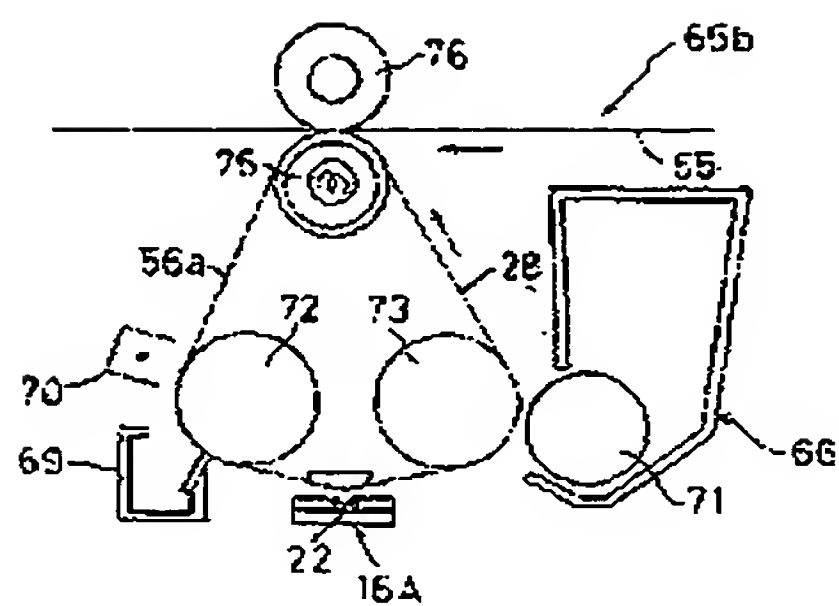
【図 19】

【図 20】

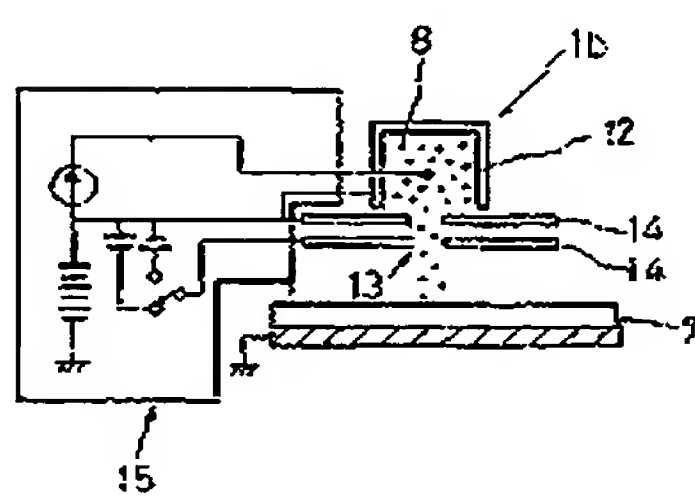
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【図21】



【図23】



【図22】

